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ENVIRONMENT, RACE AND MIGRATION

By GRIFFITH TAYLOR

A. GEOGRAPHY

- Australia, Physiographic and Economic (4th edition), Oxford, 1928
A Geography of Australasia - - - Oxford, 1914
*New South Wales - - - Melbourne, 1912
*The Geographic Laboratory - - - Sydney, 1925
*Wall-Atlas of Australian Maps - - - Oxford, 1929
Australia, a Junior Text - - - Chicago, 1931
Australia, an Advanced Text - (5th edition), London, 1949
Geographical Laboratory (North America) (2nd edition), Toronto, 1942
*Limits of Land Settlement - - - New York, 1937
Canada—An Advanced Geography - - - London, 1946
Newfoundland Settlement - - - Toronto, 1946
*Yugoslavia - - - Berkeley, 1949
**Geography in the 20th century - - - New York, 1949

B. METEOROLOGY

- *Climate and Weather of Australia - - - Melbourne, 1913
Australian Environment - (Government Printer) Melbourne, 1918
Australian Meteorology - - - Oxford, 1920
*Koeppen's World Climatology, Vol IV - - - Berlin, 1932

C. ANTARCTICA, etc

- With Scott—The Silver Lining - - - London, 1916
Physiography of MacMurdo Sound (Nat Hist Mus) London, 1922
*Hints to Scientific Travellers, Vol IV - - - The Hague, 1926
Antarctic Adventure and Research - - - New York, 1930
*Arctic Survey (New North-West) - - - Toronto, 1947

D. GEOLOGY

- The Archeocyathinae (Cambrian Corals) - - - Adelaide, 1910
*Handbuch der Regionalen Geologie, Vol I - - - Leipzig, 1940

E. ETHNOLOGY AND ENVIRONMENTAL CONTROL

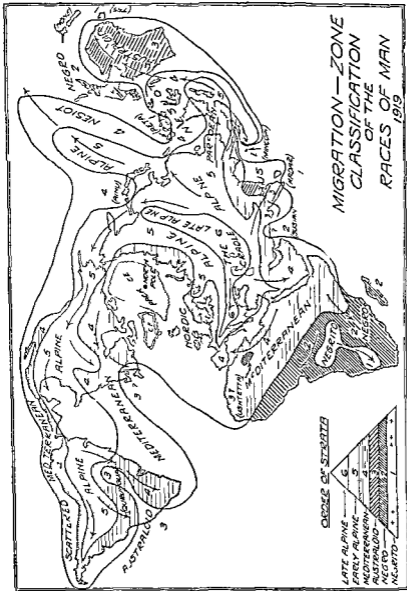
- Environment and Race - - - Oxford, 1927
(Japanese edition, 1930; Chinese edition, 1939)
Atlas of Environment and Race - - - Chicago, 1933
Environment and Nation (2nd edition) - Toronto and Chicago, 1948
Environment, Race and Migration (3rd edition) - Toronto and Chicago, 1949
*Human Origins, An Introduction to Anthropology - Chicago, 1945
Our Evolving Civilization - - - Toronto, 1947
Urban Geography - - - London, 1949

F. MILITARY GEOGRAPHY

- Atlas of Topography - - - Toronto, 1940
The New Western Front (booklet) - - - Toronto, 1942
Canada's Role in Geopolitics (booklet) - - - Toronto, 1942

*Joint Author

**Editor and Joint Author



The logical classification of the Races of Man, based on racial history and ecological principles as well as on head index, hair, etc. The zones are generalized and indicate the primitive races in the region before the modern migrations (see pp. 63 and 284). The map is slightly modified from that given in the author's paper in the *Geographical Review*, New York, 1919.

ENVIRONMENT, RACE AND MIGRATION

FUNDAMENTALS OF HUMAN DISTRIBUTION WITH
SPECIAL SECTIONS ON RACIAL CLASSIFICATION,
AND SETTLEMENT IN CANADA AND AUSTRALIA

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PREFACE

This study of *Environment, Race and Migration* is in a sense a new edition of the writer's book *Environment and Race*, published in 1927. But so much new material has been added that it was deemed advisable to indicate these additions by a slight change in the title. Among the 158 maps in the present volume, 100 did not appear in the 1927 book. The section on the environmental control of *modern* migrations has been greatly increased. Five new chapters deal with settlement in Canada, and constitute one of the first modern geographical studies of the whole Dominion. Two of the chapters on Australia are new, and a good deal more emphasis has been laid on new settlement in Siberia and Africa. The fundamental factors of structure, climate, and *changing* environment are also more fully explained for each continent.

While the first half of the book still deals with the same topics of the Evolution, Differentiation, and Dispersion of the Races of Man, yet the writer has published a number of lengthy papers on these subjects since he wrote *Environment and Race*. Moreover, in connexion with a course of forty lectures which was broadcast from the University of Chicago in 1933, he produced a small atlas dealing with race problems. Many of the maps are reproduced in this volume.

Among the subjects much more fully treated are the validity of the cephalic index in classification, the relation of Neanderthal man to the Negro and Australoid, the archeology of Egypt, the shift of forests and cultures in Europe, the expansion of the Slavs, the objections to the term "Mongolian Race", the peopling of Japan; the methods of racial dispersion, and the application of the "Zones and Strata" concept to the spread of cultures and organisms.

The "Migration Zone Theory" of racial classification was first published in 1919. The following list of the chief memoirs on this subject will summarize the development of the present volume.

- 1919 ' Climatic Cycles and Evolution (*Geographical Review* New York)
- 1921 ' Evolution of Race and Language (*Geographical Review* New York)
- 1924 Kamilaroi and White (*Royal Society of New South Wales* Sydney)
- 1927 *Environment and Race* (Oxford University Press)
- 1930 Racial Migration Zones (*Human Biology* Baltimore)
- 1933 *Atlas of Environment and Race* (University of Chicago)
- 1934 ' Ecological Basis of Anthropology (*Ecology* Chicago)
- 1936 ' 'Zones and Strata Theory of Race Classification' (*Human Biology*, Baltimore)
- 1936 *Environment and Nation* (University of Toronto Press)
- 1937 *Environment, Race, and Migration* (University of Toronto Press)

In Britain and America almost all the interest of anthropologists is concentrated on cultural problems. Roland Dixon's book published in 1923, is one of the few volumes in English which deals with the same problems as my own thesis. But in Germany there has been much more activity of late years. The new *Zeitschrift für Rassenkunde* (with which the writer is associated as Joint Editor) is largely concerned with problems of race classification. The authoritative work of Baron von Eickstedt, *Rassenkunde und Rassengeschichte* (Stuttgart, 1934), studies racial differentiation in much the same fashion as *Environment and Race*, and comes to many of the same conclusions. In America, while the anthropologists have not shown much concern with *race* evolution, journals like *Human Biology* and *Ecology* have been more hospitable to the new attack on human problems, based on ecological principles, with which I am concerned.

As regards the topics (such as "Australia's Empty Spaces") in Part III, after over twenty years of opposition it can fairly be stated that the views I advocated in 1912 are now generally accepted. Possibly this period of a quarter of a century is the time which must elapse before unpalatable views of this description can be made convincing to the educated public. The writer hopes that by 1944 his views as to *race* evolution and the relative status of Nordics and Alpines will also be generally accepted! If this be too much to ask, perhaps by that time the vast difference between *cultural* groups and *racial* (i.e., biological) groups will no longer be ignored.

It is my pleasant duty to thank several friends and firms for assistance in preparing this volume. The Oxford University Press has kindly permitted the use of some sixty maps first published in the earlier book. Most of the photographs in Plate II have been lent by the British Museum. Professor Harold Innis, whose volumes on the economic history of Canada are well known, has read the new chapters on Canada. Dr. Isaiah Bowman has allowed me to incorporate in the Australian section some new material recently published under his editorship. I have also to thank Mr. Gordon Burns (Manager) and Mrs. Alison Hewitt (General Editor), both of the University of Toronto Press, for their continued help during the printing of the book.

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PREFACE TO THE SECOND EDITION

In order to bring the book more into accord with the sub title *Fundamentals of Human Distribution*, a number of new maps have been added which illustrate the control exercised on *present day* population by temperature and rainfall. These take the form of crop maps of the several continents. The other primary factor—the distribution of the chief minerals—is charted in a parallel series of maps.

It may not be out of place to point out that the aspiration voiced in the earlier preface has been in part realized. Editions of this book have appeared in two foreign languages. My views as to race distribution and classification have been described at some length in the current *Encyclopaedia Britannica*, as well as in Eickstedt's *History of Race* (Stuttgart, 1937). Hence one may accept them as well on the way to becoming orthodox, though it will probably be many years before the obnoxious racial subdivision "Mongolian" joins "Caucasian" in the limbo of outworn terms.

Advantage of a rapid reprinting of this second edition has been taken to correct some minor errors in the text.

PREFACE TO THE THIRD EDITION

Five new maps, dealing with the structure of the Pacific Ocean, cultural composition of the Hawaiian folk, Paleolithic sites in France, early Folsom Migrations into the United States, and World isotherms, have been added to the text. New developments in Australian ethnology and land settlement (based on my recent visit) are included. With the publication of *Urban Geography* in January, 1949, this tetralogy of *Race* (1937), *Nation* (1936), *City* (1949), and *Civilization* (1947), has at length been completed.

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PART I

INTRODUCTION

CHAPTER I

THE SCOPE OF THE BOOK

The world problem of today is the adjustment of the nations to the crowding which, for the first time in history, is affecting the whole earth. While every branch of research is necessary to assist us in a satisfactory solution of this great problem, the conditions are so different from any which have obtained before that we must be cautious of following too blindly the methods which have carried us more or less satisfactorily through crises in the past. For, in addition to a remarkable restriction in the resources of the world, we have an equally remarkable increase in the aspirations of various backward

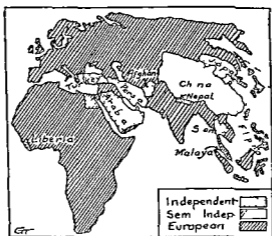


FIGURE 1 —The sole areas in the world where rulers of non European culture control the countries with large non European majorities (Hayti and Ethiopia omitted) India Burma and Ethiopia should be dotted

races. These races have hitherto been too ignorant of other peoples and other countries to realize their own potentialities. To quote concrete examples, we have on the one hand the United States strictly limiting the influx of all immigrants, whether cultured or otherwise, on the other hand we have millions of Indians and millions of Chinese realizing that their standard of living is immeasurably below that of peoples with less valuable natural resources and a much lower average of human industry. In the present stage of human evolution we find that national power depends more and more on these two material

factors, resources and industry. In the long run, an infinite capacity for taking pains will determine the status of the nation as surely as it determines that of the individual.

In Fig. 1 we see the last regions in the world which have successfully resisted conquest or control by peoples of European culture. Excluding Hayti (one of the West Indian Islands) and Liberia (in West Africa) where Negroes are in control, this "Non-European Bloc," as we may term it, extends from Egypt to the Pacific. Japan and Anatolia (Turkey) are probably the most powerful members today, but China is by far the best endowed for the future development. Of much less importance are Persia, Arabia, Afghanistan, and Siam. Egypt, Nepal, Malaya, and the Philippine Isles have a large measure of independence—which is slowly extending to India.

In Fig. 2 the point of view of the so-called "coloured peoples" is expressed graphically. The total area of the world's surface, excluding the Polar Regions, is about 53 million square miles. Of this the so-called "white races" control eight ninths (47 millions) and the "coloured" people one ninth (6 millions). The grave racial problems of today largely arise because in five ninths of the area (29 millions) the population is almost wholly coloured, but the control is by white people of an entirely different culture. The unwarranted invasion and conquest of Ethiopia (350,000 square miles), which have occurred since Gregory drew his diagram, for a time gravely increased the tension between "white" and "coloured" peoples. But now that Ethiopia is no longer controlled by Europeans, *this* "sore spot" has been healed. It is precisely because these terms "white" and "coloured" have no racial or biological meaning that every educated person should learn something of modern ethnology.

In the past it has been usual to explain national progress largely in terms of military power, religious beliefs, and sagacious rulers, as witness almost any history written in the nineteenth century. It would be foolish to deny the great influence of these factors, but there is a growing school of thinkers who believe that the environment is at least of equal importance, although the study of this factor has been neglected in the past. This neglect is a natural one, since it is only within the last half century that the environments of the various peoples have been understood at all adequately. Further than this, many scientists are coming to the conclusion that it is the *variation in the environment* which is the most potent factor of all in influencing human evolution, whether biological or social. An adequate dis-

cussion of this concept is so recent that the number of important English text books on the subject may almost be counted on the fingers of one hand, but two of the most valuable may be mentioned even at this early stage. They are Ellsworth Huntington's *The Climatic Factor*¹ and C. E. P. Brooks's *Evolution of Climate*².

We shall not progress far unless we recognize that in essence primitive man and, to a great extent, civilized man are controlled by exactly the same fundamental factors as are the other members of the animal kingdom. In the mass they are conservative and prefer the

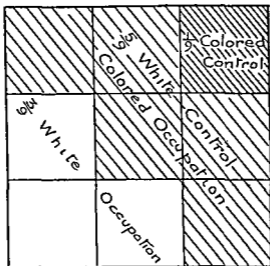


FIGURE 2—A diagram representing the land area of the globe by nine squares. It illustrates the main cause of racial unrest. The total land area is about 58 million square miles. (After J. W. Gregory.)

known to the unknown. It seems necessary to make a distinction here between the migrations of primitive man and the emigrations of people today. In modern times knowledge of distant empty lands is readily obtained, and appeals greatly to the more independent and courageous members of a given crowded group. Thus modern pioneers are often superior to many of those whom they left behind. It seems likely that this kind of differentiation did not occur in primitive times. The world was not nearly so crowded and the unknown was

¹*The Climatic Factor as illustrated in Arid America* (Washington, 1914)

²*Evolution of Climate* (London 1922)

terrifying, so that the differentiation which occurred was not of the type which occurs today. The main objective of man is to procure sufficient food and shelter to ensure the survival of the race. Only when conditions become uncomfortable, owing to overcrowding or to a change for the worse in the environment, does the tribe or emigrant leave the familiar homelands. A vast amount of evidence has accumulated of late showing that during the time of man on the earth it is this last neglected factor (the changing environment) which has led to many, perhaps most, of the migrations, aggressions, and wars which constitute so much of the history of man both in the earlier and later stages of his evolution.

As we shall see in later chapters, it is the climatic change which has affected man most directly in the past. It is much the same today. Famines due to drought are more disastrous to man than wars, which, however, are often indirectly based on the same phenomenon. One school of biologists following W. D. Matthew¹ refers the whole course of mammalian evolution to those climatic changes which have occurred most markedly in the largest land mass, the continent of Asia. As a result of these changes in the environment, the various orders of animals have been thrust out from Asia in great waves or migrations. If this is true for the Carnivores and Ungulates, it must be true for the Primates, including that section which comprises the Races of Man.

One of the main objects of this book is to demonstrate that primitive man, being subject to the same laws as other animals, has evolved and migrated in response to similar stimuli. He has been affected throughout in the same fashion, so that we find a distribution of the ethnic types which indicates a racial history almost precisely opposite to that which was taught during the nineteenth century. We were led to believe from the older text books that the centres of human evolution were those places where the most primitive races are found today. Thus Central Africa and Australia were favourite "cradles of the human race." The new ethnology teaches that the most primitive races are to be found *farthest away* from the centre of evolution of the human races. Throughout the ages the fundamental law of the survival of the fittest has obtained, but it may be expressed more exactly as regards man by the phrase "the weakest goes to the wall." The fittest tribes evolve and survive in the most

¹*Climate and Evolution (Annals of the Academy of Sciences New York 1915)*

stimulating regions, i e , where living is not so hard as to stunt mental development, and not so easy as to encourage sloth and loss of initiative. The least fit are ultimately crowded out into the deserts, the tropical jungles, or the rugged mountains.

Since, however, this "crowding out" is still occurring, we should expect to find (and *do* find) that there are a few primitive peoples still living in attractive lands, provided they be so far *distant* from the cradle lands or centres of evolution that the fitter races have hardly reached them. These primitive people are doomed to extinction, however, as we have seen in the case of the Tasmanians, the last of whom died in 1876. To quote another example, the aborigines in Victoria and New South Wales are reduced to 120 and 1,200 respectively, and a chart of their death rate shows that these tribes are unlikely to last fifty years.

I have now indicated some of the problems which I propose to discuss in the following chapters. Since the distribution of man depends so largely on the environment, which in turn is largely a function of the structure or build of a country, it seems logical to commence by a discussion of the geological conditions which have produced these structural conditions. Many readers will be unfamiliar with geology, hence the second chapter contains an elementary description of the evolution of the build of North America. The general principles discussed here apply in all the other continents.

In the following chapter is given a brief survey of the world which will draw attention to the very definite 'plan' which underlies the arrangement, structure, and surface features of the continental masses. We shall see that Asia may be looked upon as the central land from which extend three great 'peninsulas'. These are the Eur African peninsula, the Australasian peninsula, and the American peninsula.

From the ethnological point of view it is sufficient to study only the salient geographic features, such as the distribution of mountains, forests, deserts, and grass lands. These are arranged in a fairly symmetrical fashion in zones around the North Pole. This zonal arrangement has a great bearing on the distribution of man, which indeed is in no small degree directly consequent upon it.

As to the controls which dominate the distribution of man, they have obviously changed to some degree in modern times. The mingling of races is taking place so rapidly today that we are apt to feel it is impossible to disentangle the strands which are forming the

web of civilization. But modern civilization may be conceived as starting with the sixteenth century. From the point of view of the student of world settlement, this was an epoch ranking with that which marked the change from Palaeolithic to Neolithic times.

In Pre-Columbian times the races were compelled to migrate slowly. The greatest speed was that of the nomad, and he was obviously blocked not only by the seas, but to a large extent by the deserts, mountains, and dense forests. But the discoverers of the vast empty areas of America, Siberia, and South Africa, and later of southern Australia, 'turned the flanks' of all these obstructions. Their voyages led to the establishment of distant nuclei of white settlement, which soon disturbed that relatively simple arrangement of the peoples of the world which had obtained before the sixteenth century.

It will therefore be found very helpful in our study if we consider the distribution of man during two periods of history. First of all the Pre-Columbian Period (Part II herewith), and secondly the Period of Modern Migrations (Parts III and IV). This division is the more useful in that it should help to free our minds from that natural but erroneous national prejudice which makes most of us imagine that *our own race* is necessarily the highest in mental, moral, and physical status.

It cannot be too greatly stressed that the feeling of superiority which dominates the so-called "white" races is a growth of the last few centuries. It was certainly not warranted in Pre-Columbian times, and was not entertained by the humble Europeans who first came in contact with the Indian and Chinese Empires (see Fig. 83). Whatever determined the ethnological status of the various races, it was certainly not the industrial revolution of the last hundred years, which is the chief reason for the material superiority of the white races today. We know that the races were differentiated before the dawn of civilization. Indeed, one result of the study of the distribution of man is to lead the writer to the belief that the so-called "yellow" or Mongolian type of man is a later product of human evolution than many western members of the so-called "white" or European type. In other words, the Eastern Asiatic is farther from the primitive anthropoid stock, while the Negroid and many West European peoples are rather, lower offshoots from the line of human evolution.

It is obvious that if we are to understand the migrations of primitive man, which led to the Pre-Columbian distribution of races,

some knowledge of the criteria upon which ethnology is based is necessary. There is, unfortunately, no unanimity as to the classification of the major races. In the present work skull measurements and hair texture are considered of basic importance, and in association with the environmental factors (such as climate and topography and their changes) furnish the best evidence of racial affinities. It is believed that much new light is thrown on a vexed question by this association of criteria, which, indeed, has been used with great success by Ripley in his study⁴ of one relatively small region of the world.

When the general world environment and the ethnological criteria have been discussed, the study of the distribution of primitive man in Australasia is entered upon. This region was chosen because in studying organic groups it seems wise to proceed from the primitive to the more complex. Two areas, Africa and Australasia, are the last refuges of primitive peoples. The latter was familiar to the writer, from his residence therein for twenty years, and therefore the Australasian area is treated before Africa. First of all a more particular account is given of the remarkable changes in the environment off the south east corner of the Asiatic cradle land. It is shown that great areas in the East Indies have been submerged since man lived in these regions. Even more important are the changes in climate and vegetation of which the evidence in Australia is no less striking than in better known regions of the world. Much of the confusion as to the ethnology in the Melanesian Islands would seem to be due to the attempt to group all the inhabitants of the islands together. In point of fact, these islanders include races perhaps as little allied as are Bushmen and Swiss Alpines. A series of zones is shown to exist in the East Indies and in Australasia, which is so arranged that the most primitive are found farthest from Asia, and the most advanced nearest to Asia. This distribution about Asia is shown to be true in the other "peninsulas," and is of fundamental importance in discussing the evolution and ethnological status of the peoples concerned.

The Eur African peninsula is now considered. Here the racial types have been fairly well investigated. We know that the term "European" has no value as an ethnological distinction. Thus the Savoyard of eastern France is akin to the wild tribes of the Pamirs, but not to the primitive peoples of the Dordogne only two hundred miles to the west. The Corsican is much more nearly allied to the Cornishman than to the Italian peoples of the adjacent Alps. In

⁴*The Races of Europe* (London 1900)

Wales, we are told, there are small groups still essentially allied to Neanderthal man

The races of Europe can be "zoned," and the three major races are distributed around Asia in the same fashion as we have shown that the peoples of the East Indies and Melanesia are arranged

In Africa we are dealing with the most numerous examples of primitive peoples. To borrow a term from the spectrum of physical science, here the colour bands are broadest and it is easiest to trace their relations *inter se* and to the adjacent higher races. The inhospitable environment of the most primitive peoples is markedly exhibited. Indeed, in the inaccessible Negratoes of the Congo forests we almost certainly find the most primitive type of man extant.

The peoples who migrated last from the Asiatic "Centre of Development" are considered next. Asia is the land of greatest extremes of climate and topography. We have good reason to believe that it also exhibited the greatest changes in environment in the past. Whichever region we consider, Africa, Europe, Australia, or America, we find that the major migrations have always been from Asia. The dominant feature of its ethnology is the solid mass of broad skulled (brakeph) peoples in Central and East Asia. A great wedge of these folk projects into Europe and constitutes the European *Alpine* peoples. A somewhat similar wedge of peoples projects down the "corridor" of migration along the western side of the Americas. A third wedge reaches south from China into the East Indies. All round the margins of these broad heads we find a "shatter belt" of long head (dokeph) peoples. Thus on the south it extends from the Alps through the Caucasus and Himalayas to the Indonesian Islands and Melanesia.

The next chapters deal with the American "peninsula." The novel conclusion (which was first published in 1919)⁵ is arrived at that the aborigines are for the most part more closely allied to the West Europeans than to the typical "Mongolians" of Asia. In fact, they represent the relics of a zone of peoples who once occupied the eastern coastlands of Eur Asia, just as their congeners still occupy the western coastlands of the same land mass.

The last ethnological chapter attempts to weld all these results. It shows that it is not enough to link the northern folk of India with the European peoples. We must prolong this zone to include not only many of the peoples of Burmah, South China, and Indonesia, but also the peoples of many of the Melanesian Isles. Furthermore,

⁵Griffith Taylor. Climatic Cycles and Evolution. (*American Geographical Review* New York Dec. 1919 pp. 289-328 14 figs.)

most of the Polynesian peoples are akin to the Alpines of Europe, and are to be allied with most of the Amerinds on the American Continent. In other words, the peoples and environments of each continent must be treated as those of Europe have been treated, and we find that exactly comparable zones occur in them also. It is at last being accepted that there are traces in America of aborigines akin to the Melanesians, and so ultimately to that great group of humanity to which the Negroes belong.

The unprejudiced reader will feel, I believe, after a consideration of Part II, that a strong case has been made out for the later development of the broad headed peoples living now or lately in the central areas of Asia, the cradle land of the peoples of the world. The great migrations have been thrust out of Asia in four great waves during the million years of Post-Pliocene time. An attempt is made to correlate these thrusts with the later advances of the Great Ice-Sheet from the Pole, which occurred within the same period. The explanation is admittedly far from complete, but the writer knows of no other theory which supplies so adequate a "mechanism" to account for the migrations.

Having discussed the migrations of the peoples in Pre-Columbian days in Part II, in Part III we consider the effect of the environment upon man in modern times.

Probably Australia offers a region where the problems of human settlement are less hard to solve than in any other new area of equal size. Here the poor resources of the arid interior and of most of the tropical coasts are the chief difficulties preventing white settlement. The aboriginal population is negligible in this connexion, but the economic pressure of the millions of Asiatics to the north is a factor always in the minds of Australian statesmen. Yet the problem of adequate occupation is important, for there are only about 20,000 settlers in one and one quarter million square miles in the centre and north, practically one half of the area of the Commonwealth.

In this new Canadian edition it seems advisable to lay stress on a region of relatively new settlement with which the majority of the readers will be more familiar than with Australia. Accordingly, four chapters have been added dealing with white settlement in Canada. A comparison of the data here, where a cold and sterile environment is the chief handicap to the spread of settlement, with the hot arid conditions on the borders of settlement in Australia should prove interesting and stimulating. The writer has traversed the Dominion from Halifax to Victoria and north to the Clay Belt and to Tuktoyaktuk.

in the Arctic but he must confess that his knowledge of Canada is much less than of Australia. His experience as the result of twenty years of teaching geography leads him to base all regional geography upon a knowledge of structure. Hence the emphasis on that side of geography throughout these new sections, and indeed, throughout the book.

In Part IV the deductions made in earlier chapters are carried to a logical if somewhat speculative conclusion. An attempt is made to forecast the distribution of man a century or two hence. The writer hopes that this section may be found to be a useful scientific contribution to world politics.

It is assumed that Europe with its 500 millions is now fairly saturated with white peoples. The distribution of peoples in Europe is based on physical controls, such as temperature, rainfall, coal, location, etc., which can be approximately evaluated. In this discussion the world is divided into seventy six "natural regions" and their environments are classified in terms of the principal physical controls. By a graphical method *lines of equal habitability* are then drawn on the map of the world. In Europe these are equated with the present *lines of equal population*. In this fashion it is possible to estimate how many white people can settle in South Africa, Australia, and America before they are saturated to the extent that Europe is today. Asia is excluded because the standard of living of Chinese, Indians, etc., is so different from that in Europe, and their rates of increase are not at all well known. Of course no noteworthy *white* populations can settle in much of Asia, but some attention is given to Siberia.

In view of the marked decline in the birth rate, this "period of saturation" is put far forward in the future. Yet the method gives us very useful graphical data as to the relative values of the undeveloped portions of the world. The status of a nation depends essentially on its natural resources and on the numbers of its people. Thus this last section gives us at least an approximation to the status of each of the regions of the world.

It would seem to be possible that the centre of the white races will move to the lands discovered since Pre-Columbian days. Thus the North American region will lead, followed by Europe, South America, South Africa, and Australia. The most significant conclusion is in accord with the deductions of Pearl, Knibbs, East, and others, and indicates that all the useful lands of the world will be fully saturated within two or three hundred years.

THE STRUCTURAL BASIS OF GEOGRAPHY¹*A Shields and Young Mountains*

After many years of research in economic geography, the writer is convinced that a knowledge of the structure or *build* of a country is the best basis upon which to found the discussion of the relation of man to his environment. Man often changes his interests and his ways of exploiting Nature, but the most stable feature in the picture is obviously the build of the region in question. By *build*, I mean the essential geological pattern, whether ancient shield, crustal trough (syncline), or ridge (anticline), raised relic of an old range, or, lastly, young mountain, either with broad or narrow folds.

This aspect of geography has been presented in the better textbooks in Europe since 1910, but is by no means universally adopted in America, even yet. One great advantage is that it enables us to account for the distributions of various commodities such as metals, coal, oil, or water supply in a fashion impossible by the older method, which largely ignores build.

Some of us believe that the early geographical teaching, which tells us merely the 'how and where' of various products, is hardly worthy of the name of a science. The modern structural treatment, which often gives us the "why" of the distribution, is obviously a great improvement. I propose in this chapter to describe in simple language the necessary geological data. In this way we can explain Canada's place in the world plan, and then show how *build* has to a considerable degree determined man's method of settlement in the eastern area. I shall ignore other controls, such as the climatic factors, though they also are of paramount importance since they will be discussed in a later chapter (see p. 292) to which the reader is referred.

The plan of the world, if we consider its main structural elements, is fairly simple. It consists essentially of *rigid* areas (called Shields), of very *weak* areas which have yielded greatly to folding forces and so produced "Young Mountains," and of other less striking elements

¹The first part of the chapter is based on an article in the *Canadian Geographical Magazine* May 1937.

which have yielded to much less degrees. If we survey the whole land area, we find that the Shields in general surround the Atlantic and the Indian Oceans, and that the Young Mountains surround the Pacific Ocean (Fig 3)

A useful analogy is to imagine that the crust of the earth is like a rubber balloon, of which large areas have been varnished. As the balloon shrinks the varnished areas (i e., the Shields) remain rigid, but the weaker unvarnished portions are puckered into many ridges. The latter represent the Young Mountains. Possibly the floor of the Pacific Ocean is the most important unit in the crust, and is a huge unyielding area like a gigantic Shield. The occurrence of major wrinkles all round it (Fig 3), separating the Pacific area from the



FIGURE 3—The build of the world indicating the division of the crust into resistant Shields (dotted), and Young Mountain folds (broken lines). The latter have been squeezed between the Shields. Thus each continent including Antarctica, has much the same build. (Ells indicates Ellsworth's polar flight.)

smaller Shields of Canada, Brazil, Antarctica, Australia, and Siberia certainly indicates that the weaker areas have been compressed between the gigantic Pacific Shield and the smaller continental Shields. Even as regards Antarctica, the writer suggested this possibility in 1913. Ellsworth on his flight in 1935 discovered Young Mountains folded against the South Polar Shield just where the general theory suggests (Fig 3).

It follows from the above world plan that each of the continents (except Africa) consists of three major regions. The Shield lies on the Atlantic side, the Young Mountains on the Pacific side. There is a less definite area between these two, which usually takes on the

shape of a broad "crustal trough" or *syncline*. This is definitely the pattern in Canada, and each of these three types has its special economic characteristics.

Now let us look a little more closely into this process of mountain-building. It is illustrated in a simplified form in Fig 4. It is a curious fact that most of the high mountains of the world have been built of sediments laid down rather recently. On the edges of old continents the debris carried down by the rain and rivers is deposited in great belts parallel to the coast. This process of sedimentation is shown in vertical section in Fig 4. It may be that after many million years the crust becomes overloaded here. At any rate, after a long rest, on the average about 150 million years, the earth enters on a

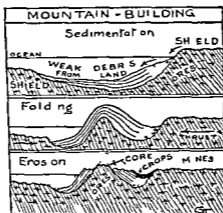


FIGURE 4—Three vertical sections through a part of the earth's crust, which is undergoing mountain building. At the top are shown sediments washed from the continent (at right) into the sea. In the centre earth folding is suggested. At the bottom erosion has exposed the ancient core rocks and washed soil (black) into the shallow downfold on the right.

period of stress and strain. The crust yields beneath the young deposits and is squeezed into folds between the Shields (Fig 4, middle). Often some of the deep seated crust is involved in the giant folds, which may extend for several miles downward. During this process the two Shields draw nearer to each other, in some cases moving through many miles, as is roughly indicated in Fig 4.

A universal feature in mountain building is that these great ridges (*anticlines*) are rapidly attacked by rivers and rain. Mountains generally receive heavy rainfall. The velocity of the steep streams is great and their erosive power much magnified in consequence. Hence we find the mountains rapidly worn away in the manner sketched in

the bottom section (Fig 4) Two very important economic results follow The core of the mountain is made apparent, when its covering of younger rocks is removed This core often contains metals derived from deep-seated sources in the crust

In the second place, the debris is washed into the sea on the seaward side, and into nearby depressions on the landward side Thus, large areas of good soil are accumulated in the shallow *downfold* already mentioned This depression naturally controls the courses of the large rivers, as for example, the Mackenzie and the Mississippi in North America The Amazon and Parana have a similar position in South America (Fig 3) Thus we have already learnt of a valuable correlation between build, metals, and crops The silts and debris washed into the downfold are shown *black* in Fig 4, bottom

Owing to the research of geologists, we have a pretty good idea of earth history and geography for the last 500 million years We also know that mountains cannot be called "old" in the sense that Shields or even rivers are old It has been suggested that some rivers have had much the same course for 200 million years, but mountains wear down relatively quickly, since they are so fiercely eroded by the rapid streams Possibly no mountains last more than 30 or 40 million years, unless they are again uplifted Hence a *high* mountain range is necessarily a Young Mountain, and is usually less than 20 million years old

This process of mountain building has occurred during many periods in the geological record but the main world wide disturbances have occurred just before Cambrian times (Fig 15), and again about Devonian, Permian, and early Tertiary times These epochs divide the last 450 million years into three more or less equal periods Indeed, twenty years ago the writer suggested² that we may have here an indication of a recurring time-cycle of about 150 million years

B *Evolution of North America*

Let us now study the past geography of North America as the findings of the geologist show it to us The long record of the rocks is indexed for us by the fossils found therein But of late the actual age of the rocks *in years* has been determined approximately by the alteration of certain radio-active minerals in them In Fig 5 are shown two stage-diagrams (each of four maps) dealing with most of

²*Geographical Review* New York, Dec. 1919, p. 320

the continent. In these maps the present coastline is indicated by a broken line. Of course in such maps any lands indicated *outside* the present coasts of the continent are largely hypothetical.³

We start our survey in the bottom left map (Fig 5), where a generalized view of the continent about 430 million years ago is

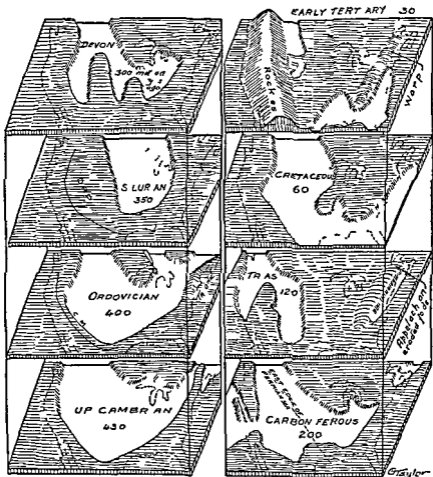


FIGURE 5—Two stage diagrams which indicate the past geography of Canada and the United States the present coasts being shown by broken lines. On the left are four maps indicating conditions from 430 million years ago (Cambrian) up to Devonian times. On the right are four similar maps which indicate the distribution of land and sea in the last 200 million years. Devonian, Permian and Tertiary times have experienced the most crustal folding. (Information secured partly from data in Chamberlin and Salisbury's *Geology*). Much land lay S W of Kansas in early Palaeozoic.

³They are based on data from Chamberlin and Salisbury's *Geology* (New York 1928).

suggested. To this period of time the name *Cambrian* has been assigned because rocks and fossils of this age were first investigated in Wales (Cambria). We cannot do more than show which was land and which sea. Clearly most of North America was a vast sea, with lands more or less near the present coasts. In the next age, about 400 million years ago, the rocks called Ordovician (such as are found between Kingston and Hamilton in Ontario) were laid down. The sea has been contracting, so that now Cambrian rocks probably formed the land margin (see CAM in the map). During Silurian and Devonian times (named from regions in the west of Britain), the sea contracted still farther leaving the older deposits as marginal lands around the shrinking sea. About 300 million years ago (see the Devonian map), there are some indications of crustal folding in the Maritimes and in the form of two ridges running into the sea from the south. But, in many other parts of the world, mountain building was very much more to the fore at this time.

Turning to the four later diagrams on the right (Fig 5), the continent in the Age of Coal is sketched in the bottom chart. The sea has now become wider, but in later periods it became shallow or even changed into great freshwater lakes. Vast peat bogs developed, which gave rise to some of the greatest coalfields in the world. In Permian times, about 150 million years ago (not shown in a map), huge mountains developed in the Appalachian region, and most of North America, except the south west corner, was probably dry land. (The edge of the main Permian sea is indicated in the Carboniferous map.) In Triassic times we see the relics of the Appalachian Mountains, and the seas are still rather small. Great masses of granite in British Columbia built up the "ancestors" of the Coast and Selkirk Ranges in Jurassic times. This period is not shown in a map. In Cretaceous times (60 million years ago), the seas were expanding again, especially to the north. The Canadian Prairies and Western Plains of the United States are largely formed of sediments laid down in this sea.

In early Tertiary times, say 30 million years ago, the Rocky Mountains were developing, largely where the Cretaceous sediments had been laid down in the western half of the sea (Fig 5). At the same time, the relics of the old Appalachian folds (almost completely worn down in Cretaceous times) were now warped up *en masse* without folding. The Appalachians consist of sharply folded strata, but this was due to Permian folding 150 million years ago. These relic

mountains now rise in places to 6,000 feet, but this uplift occurred within the last 20 or 30 million years. All through Tertiary times there has been folding, accompanied by earthquakes and volcanoes, along the Pacific Coast. In Europe this period of folding is known as the "Alpine Storm." High as the Rockies are today, they were

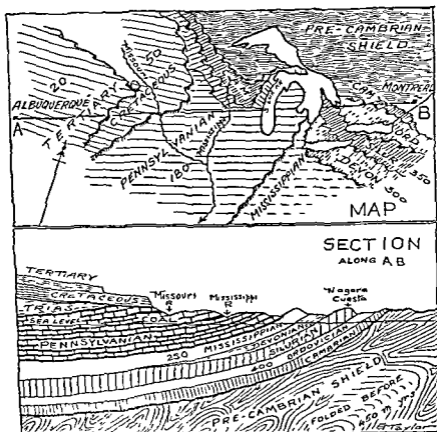


FIGURE 6—A mantle-map (a simplified geological map) of the region between Montreal and Albuquerque (New Mexico) showing that almost all the geological formations are represented in regular sequence. Below is a vertical geological section (somewhat simplified) along the line AB. Figures represent millions of years since the formations were laid down.

higher in middle Tertiary times. To sum up, we see that in Canada, as elsewhere, the chief mountain-building occurred in Devonian (Acadian), Permian (Appalachian), and early Tertiary (Alpine) times.

After the preceding introduction, the reader will be able to interpret the map at the top of Fig. 6. Here is the geological map, somewhat

simplified, of the country between Montreal and Albuquerque in New Mexico. A journey from east to west along this line takes us across almost all the formations in a regular sequence from oldest to youngest. The map emphasizes *the edges of the formations*, so as to show that the younger strata lie like "mantles" over the older strata. To this sort

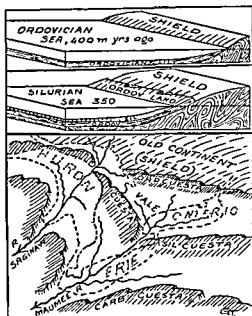


FIGURE 7 — The build of south west Ontario. In the two top diagrams the seas which laid down the rocks upon the Ancient Shield are reconstructed. In the lower mantle map the build as affecting the pre-glacial rivers is sketched. The lakes are seen to occur in broad vales east and west of the hard Silurian Cuesta. (Partly from Hobbs)

of a map I have given the name *mantle-map*, and it stresses structure more definitely than does the ordinary geological map.

Let us now imagine that we have made a deep vertical cut across America along the line of our journey, and that the southern part is removed. The vertical face would appear something like the section forming the lower part of Fig. 6. Here are the sediments, laid down in all the seas as shown in Fig. 5, arranged one above the other. Under all the formations appears the Shield, which comes to the surface near Kingston, in Canada, at the right of the section. The

edges of the formations or "mantles" crossed in the traverse can be identified in the section below. The route climbs to about 3,000 feet above the sea in the west at Albuquerque, which, of course, shows that much uplift of the crust has occurred, since most of the strata in the section were originally laid down as horizontal beds *below sea level*.

The relations of structure to geology are indicated to a larger scale in Fig 7. In the top diagram the edges of the sea in Ordovician times, about 400 million years ago, are shown as washing the continent. At that time the Laurentian Shield, i.e., the immensely old rocks found over the whole north east of Canada, had much the same appearance as today. The front edge of the section shows the sediments being deposited on the floor of the sea, and forming a layer of Ordovician silts and sands. In these silts were buried such fossils as simple trilobites which characterize that particular age. The middle diagram shows the sea in Silurian times retreating to the west, and the Ordovician rocks now help to form the coasts, while Silurian sediments are covering the sea floor. We can picture this process going on during much of ensuing geological time. Thus we learn that the geological map (Fig 6), in general, shows us the *sea floors* at the specified time, where the silts, etc., were laid down. The position of the continents in earlier geological times has to be inferred from the distribution of coastal deposits, etc. Formations laid down in fresh-water or by wind are relatively rare.

Today, the rocks in southern Ontario are arranged much as in the mantle map at the foot of Fig 7. The edges of three mantles or strata are indicated. Of these, the edge of the Silurian strata actually stands out like a great scarp or *cuesta*, which is very prominent near Hamilton. Indeed, it is the flow of the Niagara River over this *cuesta* which constitutes the Falls of Niagara. In the diagram the present position of the Great Lakes is indicated, and also the drainage of the region before the Great Ice Ages, i.e., before the last half million years. In those days the rivers drained towards the Mississippi, and their wide deep channels, though now largely abandoned by rivers, are being used by man for canals, as near Chicago.

The lakes have been cut out of the softer rocks between the *cuestas*. Georgian Bay and Lake Ontario are in the flattish Ordovician area to the east of the great Silurian *cuesta*, and Huron and Erie to the west of this *cuesta*. Further details of the topography of this region will be found in Chapter XXIII to which the reader is referred.

In Fig 8 a structural feature of great significance in relation to

economic resources is sketched. Our best example is just south of Canada, but samples of this type of structure are common in all regions of gentle folding. In the top sketch appears a layer of peat or coal covering two worthless sets of strata. In the middle diagram (Fig 8) the level beds have been gently folded to form two ridges (*anticlines*) and three basins (*synclines*). As we have already learnt, these ridges are in a dangerous position by virtue of their *elevated* position, and their summits are soon cut away by erosion. This gives us the topography shown in the middle block diagram. It is very close to the actual structure in the Middle West of the United States. Clearly the coal will have vanished in the anticlines, but will be

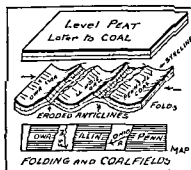


FIGURE 8—Three sketches illustrating the importance of structure in determining the presence or absence of coal. The locality studied extends from Iowa to Southern Pennsylvania. Two anticlines and three synclines are shown.

preserved in the synclines. The lower map shows the coalfields of this area as given in any good atlas. But the writer hopes that the central block-diagram gives a simple explanation for this rather peculiar distribution of the coal. The coal of Northern England is distributed in an exactly similar "eroded anticline" which constitutes the build of the Pennine Range.

In Fig 9 the writer has indulged in a geological whimsy! Six common articles are represented on the map of eastern North America, each representing the dominant structure in the area covered. Thus, over New Brunswick we have a "saucer" or syncline, containing coal in the centre, just as is illustrated in Fig 8. In this basin, as in all others, the younger rocks are preserved in the centre of the basin. They are found in Prince Edward Island, with

older rocks constituting the margins, as in Nova Scotia (see also Fig 110) Another similar "saucer" or basin, also with coal, occupies Pennsylvania

Covering most of the north of the map in Fig 9 is the Great Shield This is built of extremely old rocks, often folded and cracked and permeated with gases and heated liquids in the far distant past—before 450 million years ago It was all worn down nearly to sea-level before Cambrian times During most of the geological record it has remained almost unaffected by folding It is worth while looking at Fig 5 to see that, whatever happened elsewhere, the Shield

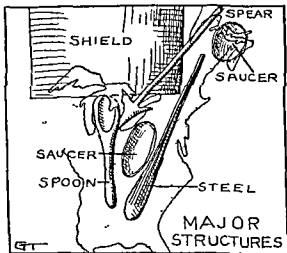


FIGURE 9—A geological whimsy to enable the young student to remember the main structures in the eastern part of the continent The saucers contain coal the other three structures are formed of old rocks and contain some metals

remained much the same low, level land area It is today one of the world's storehouses of metals, partly because it is so old, and so has had many "chances" to be affected by mineral bearing solutions, partly because it has never been deeply covered by other formations (excluding glacial debris), and so is easier to prospect by the miner

Lying across the Shield is a set of old strata (Silurian, etc), which in plan resembles a spear or harpoon The barb is formed by the hard Silurian cuesta, which runs across Ontario just west of Toronto Further to the west we have a giant "spoon," whose bowl is a syncline containing the Michigan coal Its handle is an "eroded anticline"

(running through Cincinnati), and in this no coal is to be expected (Fig 8) Lastly, to the east is a series of rather ancient rocks with striking longitudinal ridges This constitutes the Appalachian Mountains I have compared it to the "steel" with which dinner knives are sharpened The ridges will remind us of the parallel folds produced by mountain building far off in Permian times, some 150 million years ago

In Fig 10 some of the structural information so far discussed is applied to a block-diagram of Southern Canada This map is a particular example of the general type shown at the bottom of Fig 4 Here we see the young weak rocks of Western Canada folded in a

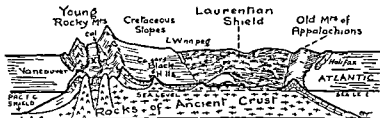


FIGURE 10—Profile section of Southern Canada (much generalized) A series of weak sediments originally deposited in a wide Cretaceous trough was buckled up (early in Tertiary times) between the Pacific and Laurentian Shields and formed the Rockies These have been greatly eroded and the old core rocks exposed In the east the old Appalachians were lifted *en masse* without folding (K = Kamloops)

somewhat complex fashion to form the Rocky Mountains In the centre of the folds the old core (crosses) now appears through erosion The old (Jurassic) granite ridges of the Coast Range and Selkirk Range are shown by inverted V signs In these igneous rocks we find the valuable silver mines, north of Trail, B C, and the gold mines in the Cariboo district The flanks are of younger rocks, mainly Cretaceous These contain good coal but no metals Accordingly, there are valuable coal mines on the far western margin at Nanaimo (in Vancouver Island) and at Crow's Nest, on the eastern slopes of the Rockies The oilfields of the world are usually found in the outer gently folded slopes of Young Mountains Here the oil "domes" are likely to occur Accordingly, near Calgary we find our best Canadian oilfield

The dry conditions at Kamloops, B C, leading to irrigation amid the numerous cactus plants growing there, are obviously a direct

result of the mountain folding. The high mountains along the coast prevent the moist winds from benefiting Kamloops in the lower central valley of British Columbia. The rich prairie lands east of Calgary have received much of their soil from the erosion of the Rockies, and this in turn is largely due to their uplift. The lately elevated Black Hills just over the border in the United States offer a perfect example of a little "eroded anticline," where the old rocks in the core contain valuable veins of gold.

The Laurentian Shield appears on the right, one of the largest areas of "primeval crust" on the face of the earth. Its importance as a producer of nickel, gold, silver, and radium need not be emphasized here. In the far east, the northern end of the Appalachian folds helps to build up the Maritimes. But, as we have learnt, these mountains are far older in origin than the Rockies and their discussion has caused us to delve down over 100 million years into the past geography of Canada.

C The Topographic Cycle

It will be time well spent if we follow the complete history of the erosion of a mountain range (Fig 11). We shall then have the key to the origin of almost every scene in the normal landscape, and it is unnecessary to dwell on the intimate relation between hill and valley on the one hand, and man and his activities on the other. We may picture the crust after a very long period of quiescence appearing something like the sketch at *A* (which may be taken to represent the Prairies of southern Manitoba or Russia). Here river soils form a plain covering four layers of fairly horizontal weak rocks. Now let us suppose that mountain building affects this area. The folding produces an anticline such as that shown at *H*, which represents approximately parts of the Rockies or Alps as they appear today. The top of the folds has been eroded. The hard core of the ancient crust now appears as the summit of the range, while younger layers (2-5) mantle the slopes, being eroded according as they are more or less resistant. We may imagine further that erosion continues for many million (perhaps 100 million) years. The mountain range is worn down to a flat rocky peneplain (shown at *B*). Notice that the peneplain consists of ancient rocks cut to a level, while the true plain is built up of layers of recent soils, etc (as at *A*). This sort of landscape (*B*) is common in Finland, or in the "Barren Grounds" of Canada.

Now let us imagine our peneplain (*B*) elevated to some 3,000 feet, as has happened in Norway. At once the rivers trench deeply into

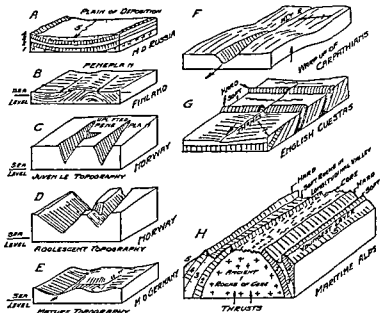


FIGURE 11 —The main topographic types which are repeated throughout the world. A young level plain due to deposition of alluvial etc., is sketched at A. An old near level plain (*peneplain*) due to erosion appears at B. On elevation of B and early river-erosion we obtain C. As the original peneplain vanishes we get D. When it has all been eroded and the hills rounded we have E. Finally a peneplain as at B, is produced again, thus closing the Cycle of Erosion. A local upward warp across a river (Alt) produces a gorge as at F. When the hard beds in a basin are exposed by erosion, *cuestas* are developed as at G. Major mountain folding often converts A into H as shown in the Alps. Geological sections are shown at the front of A, B, G, and H.

the edges of the elevated peneplain. They are marked by many waterfalls, and gradually cut canyons deeply into the plateau. In Greenland such canyons penetrate nearly 200 miles into the plateau. For long ages there is still much of the flat peneplain surface left—and in this condition the topography, including the river valleys, is said to be *juvenile* (C). Further erosion broadens the valleys, which are called *adolescent* when the last of the flat peneplain is vanishing (D). Then comes *maturity*, shown at E, which is the common type of landscape in much of the central United States or Germany. Finally, and very slowly, the rivers wear away the rounded hills until the peneplain stage (at B) is reached again. Broad valleys often develop, filled with silt under certain conditions, in which rivers meander lazily with very

little velocity. Such rivers are said to be *senile*. We have now completed the "topographic cycle," and it should be realized that in scenery, unlike the human subject, the younger it is the more interesting it is. Waterfalls, canyons, high crags, snow mountains, and everything the tourist most admires are the direct result of fairly recent uplift. The dreary plains of Finland or Northern Canada represent the end of the cycle and the old age of scenery.

One or two other types of landscape are sufficiently common to merit a little attention. It is rather usual for a small portion of the crust to be warped up, often right across the bed of a river (as at *F*). If it is a small river, it is usually blocked and a lake results. Such warps in part account for the great lakes of the St. Lawrence. But if it is a large river, often enough it can cut down its bed as quickly as the warp rises across it. We get as a result an *antecedent gorge*. Some of the best in the world occur on the Danube River, notably near the Iron Gates in Rumania. Here the young fold of the Carpathians has risen across the Danube. For hundreds of miles on each side of this locality, the Danube winds through flat plains in a *senile* condition. But just above the Iron Gates (in the Kazan Gorge) it flows through huge precipitous granite crags which are less than a quarter of a mile apart. The popular idea of an earthquake *crack* enabling the river to pass the mountain is far from the truth. We learn from such scenery that the river is far older than the mountain. The Alt River, a much smaller stream than the Danube, also cuts through the Carpathians about a hundred miles to the north east.

It is readily understood that the *harder* layers in a basin (or syncline) resist erosion, and so their edges stand out as bold scarps or *cuestas* as at Niagara Falls. Two such *cuestas* are sketched in Fig. 11 at *G*. It is fairly obvious why the river can cut only a narrow gorge through a hard *cuesta*—while it has eroded a wide valley as it crosses the vale between two such *cuestas*. But how did it make its way through the *cuesta* in the first place? In many cases these rivers are very old, and flowed (as now) towards the centre of the basin, *before* the differences between the *cuesta* and the vale were etched out so sharply. Hence the river, as in the case of the antecedent gorge (*F*), really originated in a topography unlike that seen today.

D *Glacial Topography*

Almost the whole of Canada has been profoundly affected by the Great Ice Ages which occurred during the last million years, and,

indeed, are still present in Greenland and the Arctic Archipelago. They passed away in Southern Canada about twenty or thirty thousand years ago.

Let us first consider how the Ice Age affected a fairly deep river-cut valley such as is shown at *A* in Fig 12. This type of valley was very common in British Columbia or Switzerland about one million years ago. First of all, the snow collects in high valleys and forms masses of ice which gradually cut out "arm chair" valleys or *cirques*, as shown at *B*. (The alternate freezing and thawing of the ice splinters the rocks, and this process is called *nivation*.) By degrees

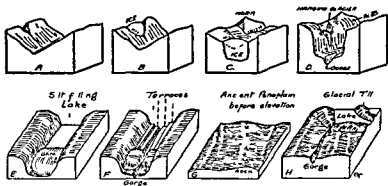


FIGURE 12—Some topographic features which are characteristic of Canadian landscapes. *A* Non-glaciated juvenile river valley. *B* Cirque glacier cutting a high level valley. *C* Valley glacier eroding valley with *U* section. *D* Post-glacial gorge cut by river. *E* Glacial valley dammed by moraine (or ice). *F* Silt deposited in former lake now being cut into terraces by river. *G* Original condition of Shield. *H* Elevated Shield partly covered by haphazard glacial till.

the Ice Age increases in severity. The cold layers of the atmosphere descend still further, so that the lower valleys receive heavy snow falls. Great valley glaciers are now produced, as shown at *C*. These are armed on their 'soles' by pieces of rocks, and so 'rasp out' the river-cut valley. In this way the glacier-cut *Trough* (shown at *C*) is eroded. As the Ice Age vanishes, i.e., when the cold layers of the atmosphere rise again, only the small cirque valleys contain some ice, which usually hangs down the sides of the glacial trough, as shown at *D*. Often enough the large supply of water from the melting glaciers cuts a deep notch or gorge in the flat rocky floor of the glacial trough.

In British Columbia many of the deep valleys were (and are)

dammed by ice or moraine, as shown at *E*. These hold back large sheets of water—which are slowly filled up by the silt and debris washed in by the rivers entering the lakes at their upper ends. In time the elongated lake basin may be wholly filled with such silt. When the ice-dam vanishes (or when the moraine-dam is notched by the river), these soft silts are readily cut down by the river to form well marked terraces, as shown at *F*. In British Columbia, the minor elevations to which the region has lately been subjected, have also helped to produce these remarkable terraces⁴. Near Ashcroft, and elsewhere in the Thompson and Fraser Valleys, these terraces are of great value for agriculture, and can readily be irrigated. Often enough the river cuts gorges into the rocky floor of the canyon, when it has removed all the morainic debris (or lake silts) which covered it.

In the eastern portion of the Dominion, the region before the Great Ice Ages consisted of a very remarkable type of topography—the Laurentian Shield—to which reference has already been made. This was probably largely bare rock—in the form of the last stage of normal erosion, i.e., the *peneplain*. It is sketched at *G*. Old rivers meandered sluggishly over it, for we may believe that it was little above sea level.

It is somewhat difficult to explain simply the "topographic condition" of the "Laurentian Shield," as it appears today, for two reasons. First, it has been elevated (though not folded, of course) in many areas to a height of one or two thousand feet above the sea. Secondly, almost the whole of it has been covered with a veneer of glacial debris (called *till*), which has been dumped upon it in a quite haphazard fashion by the Continental Ice Cap which has now vanished. So recent is this dumping of *till* that the lakes and rivers have not yet developed a simple 'economical' type of drainage. This uplift and drainage are sketched at *H*. Hence the elevated Shield exhibits a curious mixture of very old and very young features of topographic evolution, and can be explained only by a discussion such as is here given.

⁴My later investigations suggest that these terraces are not due mainly to river erosion of lake silts. There are no scalloped edges to the terraces and much of the material comes from adjacent slopes. In the Antarctic I found that all the stagnant glaciers were separated from the adjacent hill slopes by wide empty lateral moats. If a warmer wet cycle should supervene these moats might collect deposits in the form of long straight fronted terraces such as are universal in British Columbia. Some such deposition probably occurred during the various uplifts of the late Tertiary times in British Columbia. See my paper on *The Topography of British Columbia* (*Geographical Review* New York 1942).

CHAPTER III

THE GENERAL WORLD PLAN

The student who wishes to obtain a knowledge of the various environments of man is likely at first to be bewildered by their apparently infinite variety. I find it useful in my lectures to assure my students that when the principles determining the environments in one continent are mastered, those of the other five (excluding Antarctica) will be found to be much the same. We may compare the great land areas to the four suits in a pack of cards, the arrangement in one suit is repeated in the others. In effect, there is a general world plan.

A Topographic Plan

From the point of view of the distribution of man, it is probable that the customary choice of world maps in which the Atlantic Ocean is in the centre and the Pacific Ocean at the margins has distinctly hindered the progress of ethnological research. For the Atlantic has been a barrier between the New and Old Worlds throughout the ages until the time of Columbus if we except the abortive voyages of Leif the Norwegian in A D 1000. On the other hand it is generally believed that the Bering region has been a great corridor of entry from Asia into America right through late Tertiary times, and indeed, as I have suggested in the Introduction, America is to be looked upon as an eastern peninsula of the Old World.

However, a form of *Polar* projection (as used by Matthew) is undoubtedly best for our preliminary study of the world plan. Such a map with the North Pole at the centre is given in Fig 13. It shows very clearly the central Asiatic land mass with the three great continental 'peninsulas,' America to the bottom right, Eur Africa to the top right, and Australasia to the top left.

The map shows that the dominant highlands run from Central Asia westward towards Cape Town in the African 'peninsula.' The highlands next in importance constitute the Rockies and Andes of the American 'peninsula.' Finally, the region of the East Indies and Australasia is a *drowned* series of highlands, large areas of which tower 18 000 feet above the flat floors of the Indian and Pacific Oceans (see Fig 28).

It is still generally believed by the layman that the high mountains are the most permanent features of the earth's surface. Literature is full of references to the "old, unchanging hills." In point of fact, as has been stated earlier, erosion is so much more rapid on the exposed surfaces of mountains and plateaux, with their swift rivers and streams eating into the steep slopes that it is not till such land forms are worn down to their roots to form *peneplains* (Fig 11 at B) that they attain a stable position.

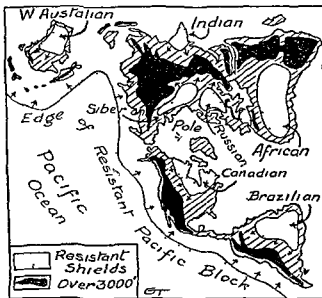


FIGURE 13—The Old World with its three peninsulas—America, Australasia and Eur Africa. The North Pole is at the centre of the map. The floor of the Eastern Pacific is probably a resistant block (or Shield) against which the Young Mountains have been folded. The black areas in Siberia and East Africa are also largely elevated shields. (See Fig 16)

The most permanent portions of the earth's crust are the very ancient land surfaces which are called 'coigns, or more graphically 'Shields' (These are dotted in the diagram Fig 13). These Shields flank the Atlantic and Arctic Oceans while the greatest elevations of today, as we have seen flank the Pacific and Indian Oceans. The most important "Shields" are found in Brazil, East Canada (Laurentian), East Siberia (Angara), all Russia and Western Africa. There are two near the Indian Ocean, of which the less important constitutes the Deccan (South India) and the other West Australia.

Many geologists believe that this arrangement of the earth plan

is a relic from the original cooling and contraction of the molten earth. A similar deformation occurs, as Hobbs points out,¹ when a hollow sphere made of thin metal is gradually exhausted of air. The sphere contracts and tends to assume a tetrahedral (or pyramidal) form, which has four faces, four corners, and six edges (Fig 14). Without going too deeply into this "tetrahedral" theory, we can see that it gives us some explanation for the world plan. It is, indeed, remarkable that it was suggested by Lowthian Green in 1877. This was many years before the discovery of the deep ocean at the North Pole (in 1894), and of the high continent at the South Pole (in 1902), strongly supported his hypothesis.

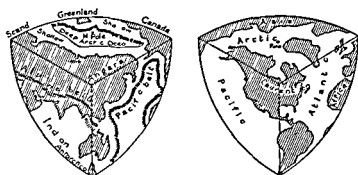


FIGURE 14—The Tetrahedral Theory showing the oceans opposite (i.e. antipodal to) the continents. The pyramid form is, of course greatly exaggerated. The major Shields are at the four corners and the oceans on the flat faces.

Let us suppose the tetrahedral earth stands on one corner. The waters of the tetrahedral earth would collect in those portions nearest the centre of the earth, i.e., on the four flat faces. Hence we may explain the Arctic Ocean on the (upper) horizontal face, and the Pacific, Atlantic, and Indian Oceans on the three other faces. The four corners of the tetrahedron are explained as the coigns found in Antarctica, in Eastern Canada, Russia, and Siberia. The three (sloping) edges of our tetrahedron are the three "peninsulas" of America, Africa, and Australasia, to which I have already referred.

¹See *Earth Evolution* (New York 1921). It is the *symmetry* of the world plan which is concerned in man's distribution. Whether the Tetrahedral or Continental Drift theory explains the origin of the world plan best is not material at this juncture. (See section D at end of Chapter III.)

B. Phases in the Geological Record

No fact in geological history is so interesting as that we live in an epoch of great earth-movement. As we have seen, only three other times in the record (i.e., in Permian, Devonian, and early Cambrian times) exhibit such crumpings of the crust, such high mountains, such great variations in climate, and consequently in environment. Thus, late Tertiary times have been of tremendous importance in the evolution of life. It is in all probability due to these intensely stimulating

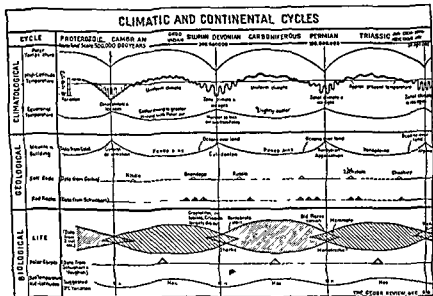


FIGURE 15—Diagram showing the four major cycles in the climatological, geological, and biological records. These major periods of environmental change (and consequent biological evolution) occurred at the dawn of the Cambrian, and in Devonian, Permian, and late Tertiary times. The Tertiary period began about thirty million years ago. (From *Geographical Review*, New York, Dec., 1919)

conditions that the highest type of animal life evolved; and the origin of man, therefore, is a necessary corollary of the invigorating environment of Tertiary times

I reproduce in Fig. 15 a diagram² which correlates the periods of great environmental change with the periods of great biological change. The reader should study the names of the great geological periods

²See Griffith Taylor, "Climatic Cycles and Evolution" (*Geographical Review*, Dec., 1919, pp 316 ff.). W. T. Forbes (Cornell biologist) corroborates this cycle of about 150 million years in his "Great Glacial Cycle" (*Science*, 1931, p 294)

(Cambrian to Tertiary) which are shown, according to a regular time-scale, along the top of this diagram (see also Appendix, p 480) The first of such periods is the dawn of the Cambrian, possibly 450 million years ago, which for long years was accepted as containing the oldest record of fossil life We now know of many fossils in somewhat older rocks but there is no doubt that some enormous change in environment including a great period of mountain building, affected life at that time During the Devonian we have another critical stage, when the 'Caledonian' period of mountain building occurred There were feeble precursors of the vertebrates before the Devonian, but the vast array of sharks and true vertebrate fishes commenced at that time about 300 million years ago At the close of the Carboniferous, about 150 million years later, the land floras and faunas changed remarkably This was the great Hercynian or Appalachian period of mountain-building Now the first reptiles crawled on the land, and we may with certainty follow Matthew and place the birth of the mammals in the Permian indeed, the most primitive mammal, the platypus, still maintains his amphibian method of life

The close of the Tertiary is marked by another period of mountain building associated (as in the Cambrian Devonian and Permian times) with a series of Great Ice Ages It marks the culminating point in life, the dawn of the human age No doubt the monkeys flourished in late Tertiary times, together with that even more *plastic* type of mammal our pithecoïd ancestor But it was the strenuous times of the Pleistocene, commencing about one million years ago which picked out the dominant type and gave to man the prominent position which he occupies

In 1925 Joly published his book *The Surface History of the Earth*³ In this he suggests much the same four "catastrophic ages" as I had done in 1919 Using his Uranium time scale, we find that these cycles also come out about 150 million years apart So far as I know, my suggestion of stellar interference which will be found in my paper on 'Climatic Cycles'⁴ is the sole attempt to explain this hypothetical cycle There also I suggested that radio-activity might account for some of the heat phenomena

Let us now return to the distribution of the mountain masses of today They are found to be puckered up against the resistant

³Published by the Oxford Press

⁴*Geographical Review* New York Dec 1919 p 328

Shields formed of the primitive crust. Modern theories assume a sagging of the crust in certain regions, especially in the great oceanic deeps,⁵ which has led to folding of the weak continental *margins* against the solid Shields. This has happened throughout the ages, so that we find the early mountain chains (e.g., the Caledonian series) rising *near* the Shield, while the later Permian folds are a little farther off, and the latest Tertiary folds (e.g., Swiss Alps) still farther off. A similar series of foldings occur between the Tongan Deep (off New Zealand) and the West Australian Shield.

These "new" mountains have only recently developed. Indeed, they are probably still growing, as has been demonstrated in the Himalayas and the Andes. Almost each year geologists tend to place the dawn of the human period farther back in geological time, while they bring later and later the phenomena of mountain building and other earth movements. Indeed, the recent work on the submerged canyons in the continental shelf off Virginia and off the River Congo, show *vertical* movements of 10,000 feet possibly in Pleistocene time.⁶ Thus the student who wishes to understand the changing environment which has determined the evolution and the distribution of man must realize that many regions of the earth may have actually changed not only in climate but in elevation and topography within the human epoch. If we include in this epoch the Pliocene as well as Pleistocene and Recent times, this may well comprise a period of some four million years.

It is a natural consequence of the fact that the great white civilizations have grown up on the relatively stable coasts of the Atlantic Ocean that the early geologists were inclined to believe in the permanence of continental morphology. In these regions near the North Sea and near the Alleghanies, though considerable changes in the continental shelf have occurred there are no such stupendous *bucklings* to form Young Mountains as characterize the coasts of the Pacific, or as took place in that "Alpine Storm" which folded the lands from Mont Blanc *via* the Himalayas to Java.

The most mobile regions of the crust, those which have suffered the greatest movement in a vertical direction are within the well known earthquake belt. Pirsson and Schuchert definitely assign the volcanic outflows of the Pacific, which resulted from these movements

⁵See section D at end of Chapter III

⁶See the memoir by A. C. Veatch on the *Evolution of the Congo Basin* (Geological Society of America 1936)

to the Pleistocene. Hence we may deduce that these movements or their effects were factors in determining the migrations of man. Especially in connexion with the old land bridges and 'corridors' connecting the large land masses is this concept of recent marginal change of paramount importance.



FIGURE 16—The most mobile region of the earth's crust. The chief fault and earthquake belt (mainly after Hobbs) is indicated by ruling. The areas covered by terrigenous deposits (derived from lands) by stippling. Much of the region shown by dots was possibly dry land in early Pleistocene time. See also p. 42. (From *Geographical Review* New York 1921.)

Let us for a moment glance at the regions where slight differences in elevation would have the most effect in blocking the migration of animals. In America there is the Panama region and the Bering region. Nearer the Central Asiatic lands we find in the south the East Indies which have been termed the Stepping Stones to Australia. In the west are the Red Sea and the Straits of Gibraltar, and in the north west we may add the North Sea.

If we refer to Figs. 3 and 16 we find that all these regions are in the belts which have been subjected to the great folding forces of

Tertiary times We know that *uplifts* of the order 10 000 feet have occurred fairly lately in this belt, and, as the submarine canyons show, downward buckles of the same order have occurred, though the inflow of the sea has destroyed most of the evidence In later chapters I shall give more fully the reasons for accepting the adjoining sketch map as a picture of late Tertiary geography Hence we see that the world plan of a million or two million years ago could be described even more closely than now as an Asiatic centre with three projections, which constitute the other continents (see Fig 13)

C Climatic Plan

We may now turn to the climatic arrangements of the world plan These are determined primarily by latitude and secondly by aspect Man has until quite lately in his history been engaged either in hunting, or in agricultural or pastoral pursuits These depend entirely upon the mantle of vegetation which covers the earth's surface We cannot do better than consider how the varying types of vegetation depend on the controls mentioned above

Let us consider the vegetation between the North Pole and South Africa (Fig 17) The most striking feature is the parallel arrangement on each side of the Equator Especially is this seen on the Atlantic coast Thus the central belt is the West African and Congo tropical forest (or *selva*) On each side of this is a *savana* belt, the Soudan to the north, the Angola region to the south Then come the Sahara Desert on the north and the Kalahari Desert to the south, each flanked on the polar side by a belt of scrub land and grass land which may be termed *steppe* Passing farther from the Equator we reach the typical Mediterranean vegetation (*Med* in Fig 17) with its cork oaks, olives, and vines This is duplicated in the south by the similar belt near Capetown To the north we pass through broad leaf temperate forests (oak elm, etc), then through coniferous forests and so reach the lichen covered tundras of the Polar Circle These last three zones are not present in South Africa for its latitude only extends to 34° south

One great advantage of the 'Tri Peninsular Plan' is that it focuses our attention on departures from the usual plan These are labelled A, B, and C in Fig 17, and their bearing on environment will now be discussed If we turn to the arrangement of the vegetation in the American 'peninsula,' we see that it is exactly the same as

in Africa, save that the Gulf of Mexico and the Caribbean Sea have taken a great bite out of America on the Tropic of Cancer. Turning to the remaining "peninsula," that of Asia Australasia, we find the same belts to north and south, but the submergence of the East Indian areas (to which reference has already been made) has modified the zoning very materially in equatorial regions.

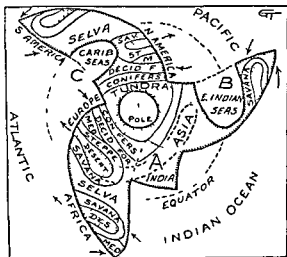


FIGURE 17—Scheme indicating the simplified Tri-Peninsular World. Here the three great land masses—America, Asia, Australia, and Eur-Africa—are shown as huge peninsulas radiating from the North Pole. The chief exceptions to this simple plan occur at A, B, and C.

The most striking interference with the simple plan indicated in Fig. 17 is, however, not due to the presence of a large sea within the "peninsula" but results from the fact that the Indian Ocean is so much smaller than the Atlantic or Pacific. The unusual position of India (A in Fig. 17) clearly gives it the remarkable monsoon climate for which it is noted. Hence the eastern side of the Eur-African land-mass does not quite follow the world plan in northern temperate latitudes. Partly as a consequence of this great spread of land from west to east (and the east is the windward side in these latitudes), the desert of Sahara extends more or less continuously across to China. This is indicated by the area enclosed in a broken line in Fig. 17. There is, as always, a belt of warm temperate forest and savanna about

five hundred miles wide on the eastern (windward) side of the desert belt

It is unnecessary to dwell on the reasons for these belts. They depend essentially on the rainfall and dominant winds (see arrows in Fig 17). The trade winds (from the east) give rains and forests on the eastern sides of the peninsulas in latitude 23° , but are drying, offshore winds on the leeward (western sides). Nearer the Poles the wet, westerly winds accompanying the temperate cyclones give rainfall and a luxuriant vegetation to the western coasts between latitudes 40° and 50° . Further details will be described in later chapters.

As regards latitude, therefore, we may generalize somewhat and arrange the vegetation zones as follows

Latitude north or south	VEGETATION ZONES		
	West aspect	Centre	East aspect
70°	Tundra	Tundra	Tundra
60° 50°		Coniferous forest (Taiga)	
48°	Deciduous forest	Steppe	Deciduous forests
40°	Mediterranean	'	'
30°	Steppe		Warm temperate forest
23°	Desert	Desert	' " '
15°	Savana	Savana	' ' "
Equator	Tropical forest	Tropical forest	Savana

Thus there are only nine types of vegetation, and these are merely repeated in the various "peninsulas", so that, to use the playing card analogy, we are concerned with three "suits," each suit (peninsula) containing two sets of nine similar cards.

How do these vegetation belts most immediately affect man? In the early days of his history, he was quite unable to cope with the dense forests, whether temperate or tropical. He had no greater love for the desert or tundra than the average man of today. Hence his chief abiding places would be found in the belt between the desert and the forests. The park land type of country, just on the drier edge of the forests, would seem to be best suited to early man. Probably the primitive Negroid peoples would prefer the warmer savana woods, while the higher races would expand on the edge of the temperate forests.

These belts would also be the great *corridors* of migration until man tamed cattle and horses, when the drier steppes would be equally

available. With the use of bronze and iron tools, some progress would be made in cutting down the deciduous forests of the temperate zone, but as regards the tropical forests, man has not even yet made much impression on them. Dr. Bowman, in his masterly study of the Peruvian Andes, writes as follows of the Amazonian forests: "The tropics must be won by the strong hands of the lower classes who are ignorant or careless of hygiene, and not by the khaki-clad, robust young men like those who work at Panama. It is pleasant to think that the tropical forest may be conquered. It is nonsense to say that we are now conquering it in any comprehensive way."⁷

It is of greater significance in the present study to realize that these belts of vegetation have varied in position during the life of man on the earth. Everyone knows of the swing from tropic to tropic of the sun during each half year. The effect of this swing is first felt as a change of temperature, and this brings about a similar seasonal swing in the wind belts and also in the rain belts. There is thus a direct connexion between the change in a temperature belt and the change in a rainfall belt.

In the four Great Ice Ages of the Pleistocene, we have the clearest evidence of remarkable changes in the temperature belts of temperate and frigid latitudes, and to a less degree of tropical latitudes. Much attention has been given to the temperature changes, and but little till lately to the changes in the rainfall belts. But it is the latter which chiefly determine the position of the deserts, steppes, and parklands, and therefore we feel sure that the environment best suited to man swung north and south with the fluctuations in the temperature during the Pleistocene. The same phenomena have occurred to a less extent since the last Ice Age, and it is this changing environment which has very largely led to man's evolution and to the differentiation into the various races with which we are familiar today. Further, we have in these climatic changes the most logical explanation of the migrations which characterized the early history of mankind.

We may briefly refer to the thesis of Part II at this juncture. In the Ice Ages the expanding ice fields of Northern Eurasia drove away the forest belts towards the Equator and also the animals, including earliest or Negroid man, who dwelt therein (Fig. 97). Some tribes remained isolated or lost in the equatorial regions and evolved little, for there was no stimulus there then any more than there is now. Those tribes who survived in or near the cradle land, or who returned

⁷Isaiah Bowman, *The Andes of Southern Peru* (New York 1916) p. 34.

with the stimulating environment to the Central Asiatic region, continued to be subjected to climatic stimulus of a pronounced type and gradually evolved into peoples akin to the Mediterranean race. The onset of the next Ice Age led to their dispersion, but those who returned to or still remained in Central Asia were developed into still higher types of race in the next long interglacial. So arose the Alpine races, including many of the European peoples. These races were dispersed in irregular zones all around Asia. Science already recognizes the European affinities of the Polynesian, but I would claim even closer affinities for some of the Melanesians of the Solomon Islands and adjacent regions. I also believe that the Amerinds should be zoned in the same fashion, so that the Arawak and Carib peoples and many of the Plains Indians of North America belong essentially to the same zone as ourselves.

D Note on the Evolution of the Continents

The illuminating book by Joly, *Surface History of the Earth*, should be read by all interested in the causes of the earth plan. His thesis is perhaps easier to accept than Wegener's theory of "continental drift." Joly believes that the continents represent a "scum" of lighter refractory granite, etc., floating on a heavier layer of basalt some seventy miles thick, which also forms the ocean floors. The basalt is heated to melting point at the end of every cycle, by accumulated heat due to the decay of radio active metals.

Thereupon the tidal drag (due to the moon) acting on the continents can hold back the thinner *lowlands* of the crust, while the deep and high continental masses are less retarded, and are moved somewhat to the east in the fluid basalt. (Similarly the huge icebergs move north from Antarctica quicker than the thinner pack ice.) Joly suggests that South America may have moved east of North America because of the higher and deeper Andes. So also New Zealand has outstripped Australia. The tidal drag to the west helps to explain why the crust often cracks in north-south rifts at the margins of the great oceans and why the mountain building generally takes place here also.

The present writer has not been much impressed by the widely discussed 'Theory of Continental Drift' put forward by Wegener and others in many books and papers. The similarities between the faunas and floras of the southern continents can be adequately explained without imagining that Africa, Australia, Antarctic, etc., once

lay "cheek by jowl" For instance, the primitive peoples living in the tips of Africa, Australia, and South America are somewhat akin. But their kinship, as we shall see, dates back to a *common origin* in Asia. It certainly does not indicate that the three southern continents once adjoined each other.

E Note on Pacific Structures

If we examine a detailed topographic map of the floor of the Pacific Ocean, it is possible to distinguish two different regions. The Central Western Pacific is marked by a great number of crustal folds—shown by the numerous "festoon islands" to be more or less concentric about the Australian Shield. The remainder of the Pacific area, lying east of a line joining Hawaii, Marquesas and New Zealand, is on the whole not so deep an ocean, but has a much more level and undisturbed character. Clearly the eastern portion has much the character of a Shield, though it happens to be submerged by the sea. It is interesting to note that the western "folded" portion of the floor is antipodal to the central portion of the Atlantic Ocean, between Brazil and the Gulf of Guinea. This would seem to strengthen the arguments for the Tetrahedral Theory of the shape of the World, in which the *undisturbed* ocean areas are in general antipodal to the folded or epeirogenic (widely elevated) areas. (Figs 14 and 16.)

There are about 95 million square miles in each of the two groups.

F Age of the Earth

In the magazine *Endeavour* for July 1947 Arthur Holmes gives a table of ages of rocks as determined by radioactive measurements. They agree closely with those suggested by the writer in 1919.

<i>Age</i>	<i>Holmes</i>	<i>Taylor</i>
Permian Mountains		150 million years ago
Late Carboniferous	210 mill on	
End of Devonian	255	
Middle Devonian Mountains		300
End of Ordovician	350	
Upper Cambrian	440	
Cambrian Mountains		450

These figures support the writer's thesis that the three major mountain building periods (shown in Fig 15) occurred at intervals of 150 million years.

CHAPTER IV

ETHNOLOGICAL PRINCIPLES, NATIONALITY, AND LANGUAGE

A *Ethnological Principles*

The science of ethnology is so largely a product of Western European peoples that it is natural for all classifications of the races of man to accept as a fundamental principle that this group is the highest type in human evolution. In this study we are concerned with ethnical not ethical status, with material rather than with mental status. Indeed, our problem is mainly biological at first, and concerns physical rather than cultural anthropology. Later on we shall dwell on the economic status of peoples at some length.

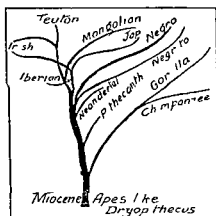


FIGURE 18 —A conventional (and unsatisfactory) Ethnological Tree

A well known method of exhibiting racial relationships is by means of an "ethnological tree" (Fig 18). Here it is assumed that there are certain root stocks from which arise various later ethnological branches and twigs. Thus from a root stock or main stem of ape-like creatures, we find a low abortive branch given off which represents *Pithecanthropus*, the ape-man of Java. A little higher is a branch representing *Eoanthropus*, the primitive man of Piltdown. Modern types are foreshadowed by *Homo Rhodesiensis* (from Broken Hill, Rhodesia) or *Homo Neanderthalensis* from the Neander Valley near

Dusseldorf It is believed by many ethnologists that the Negro races descended from types not unlike those just specified, so that the large group of Negro peoples would be represented as branching off hereabouts Then later we should find branches labelled Mongolian and Caucasian, with all the hundreds of yellow and white peoples of today indicated by twigs on these branches

I do not propose in this study to discuss in any detail current theories as to the relative status of such extremely primitive types as those preserved at Piltdown, Broken Hill, or Trinil (in Java) There are no living species akin to these animals, and our brief study is

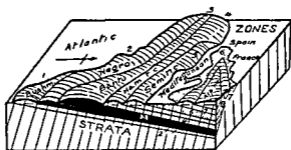


FIGURE 19—A much generalized block diagram of Eur Africa illustrating the migration zones from Cape Town to Russia. It shows the order of various racial (or cultural) strata submerged by later migrations.

necessarily confined to the peoples of today. But since the 'ethnological tree' is still used, it seems well to point out that it does not illustrate at all closely the phenomena which characterize racial differentiation and dispersion. For instance, Wells, in the preceding Fig. 18¹ has to merge very distant branches to form the Japanese and Irish respectively. I venture to suggest that ethnologists would have done better to borrow from the geologist rather than from the botanist for an analogy to the ethnological processes. For we are here dealing not only with horizontal distribution but also with vertical distribution. The ethnologist of today learns as much from "fossil" evidence of earlier inhabitants as from the characteristics of the races who still occupy the region under investigation.

These features can both be combined in what is really a development of the "block diagram" of the geographer and geologist. In

¹The early chapters of the *Outline of History* with their admirable illustrations furnish an excellent summary of the history of primitive man.

Fig 19 this arrangement of *Zones and Strata* is shown in a very generalized form. We are supposed to be looking to the west over Europe and Africa. The distribution of the races is shown, with the most primitive zone (Bushmen, etc., No 1) to the south (left) and the latest arrivals (Slav-Alpine group, No 8) in the north (right). Each zone may be conceived as pushing the preceding away from Asia, as indeed can be shown to be the case. The mixing of races which inevitably takes place where one zone comes in contact with another is much more logically deduced from this type of diagram than from the "tree". This block diagram also shows clearly that the retreating

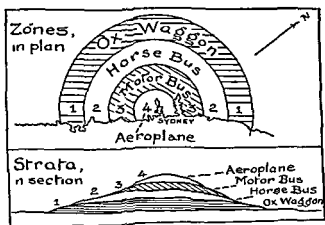


FIGURE 20—The Evolution of Transport used as an analogy for the Evolution of Races. The centre of stimulus (Sydney) is surrounded (in plan) by zones of evolution. In section (in an engineer's dump heap) the same order of strata is present.

races leave relics of their sojourn in the shape of buried "strata". These may consist of actual graves, artefacts, hut sites, etc., or of place names and folk lore, or of some traces in the form of hybrids, or even of small groups of refugees still living isolated in rugged mountains. This may be called the evidence from stratification, and this concept of *Zones and Strata* will frequently be appealed to in the text.

Evidence is indeed accumulating that the Palaeolithic folk of Europe were much more closely akin to races now living on the periphery of the Eur African region than was formerly admitted. Sollas advanced this thesis in a general way in his stimulating book

Ancient Hunters but it seems to me that the principle can be applied in every part of the world

We can gain a still more valuable picture of race dispersal if we consider an analogy which comes within the experience of everyone. We may call it the *Analogy of the Evolution of Transport*. In the vicinity of any large city such as Sydney, as we move farther from the centre of industry we find more and more primitive methods of transport (see Fig 20). Thus in some of the rough forest country about a hundred miles away settlers still depend on the primitive ox wain with its team of oxen. A little nearer we find a zone where the four wheeled wagonette is the chief conveyance. Nearer again we find the old yellow omnibus which once carried the traffic of the city. On the margins of the city the motor buses have displaced these more primitive vehicles. Finally over the city we find aeroplanes frequently hovering and exemplifying the latest development of transport.²

So much for the *Zones*. Now let us visit a large engineering repair shop in the city and inspect its heap of scrap-iron and waste material. We shall perhaps find a broken air propeller on the top of the heap. Beneath will be countless relics of motor buses, covering old carriage springs and fragments of horse-drawn vehicles. Finally at the bottom of the heap we may find an old ox yoke or similar evidence that some hundred years ago the ox wagon was a common sight in the streets of Sydney. Obviously cultural debris will also be scattered over the country side within the zones in similarly arranged layers. So much for the *Strata*.

Here then we have a close parallel with the *Zones and Strata* which are indicated for the peoples of Europe and Africa (Fig 19). But the most valuable concept is yet to be elucidated. It gives us a key to the evolution and status of the various races involved. In the case of the vehicles we saw that each member of this series of types first developed *in the same centre* where the stimulus was greatest and was driven out as the better types evolved. Here no doubt commercial competition was the chief factor. Moreover the most primitive type is naturally now found farthest from this centre of maximum stimulus. Lastly the agreement between the series of the zones and the strata shows us the *order of evolution* and in a sense the relative status of the objects in question.

²See M. Grant on Zones (*Proceedings of the Pan-Pacific Congress Tokyo 1923* p. 253).

This, then, is the chief contribution which the geographer can bring to ethnology. It is indeed an amplification of this which forms the text of the first portion of this book. It seems clear to me that we have an exactly parallel case to our Transport evidence in our Racial evidence. We can show the same series of zones about a common centre in Asia. We can show that the climatic stimulus was greatest in Central Asia. We can show that the most primitive races are farthest from this centre, and that a similar series of zones is preserved in somewhat the same order if we dig down through the Recent and Pleistocene strata in Europe and North Africa.

Two novel conclusions are foreshadowed. First, that Europe was settled in somewhat the same order as that of the zones in Africa, and secondly, that the West European peoples (British, North French, North Germans, Spanish, etc.) are probably an earlier development of man than those living in the centre of dispersal, i.e., the Alpine Mongolian group of peoples.

Let us now consider some of the features of a race migration. They have been somewhat the same throughout the ages, and a modern 'migration' such as that of a city crowd to a football match, presents some useful analogies. First come the lowest classes and pariahs, who wander freely over the ground long before the general public arrives. They have arrived there by the usual roads and tracks, but ultimately are found perched in tree tops and in the least attractive positions of the ground. Then the proletariat advances *along the same roads and corridors*. Later, they are driven out of the best seats which are reserved for the last comers.

In the past history of man his various migrations have advanced from Asia along the same corridors, which were determined by the topography and vegetation as we saw earlier. Thus Europe during the early ages was invaded chiefly by way of the south-east. Australia has always been entered by the East Indian corridor, and America by the Bering corridor. The latter case is the most instructive for we shall see that the last comers still hold the corridor in America and have not yet had time to drive the earlier peoples away from the best regions. Yet these more powerful later tribes have disrupted their predecessors and driven great numbers into the rugged hills or distant forests on both sides of the line of migration (Fig. 92). So also on a smaller scale the primitive short dark folk of Britain were driven west into Cornwall and east into the *Cambridgeshire fens* by invaders from the continent. Further disruptions of the same nature

occurred when Africa was reached from Asia, and so the Western Abyssinian highlands are full of the early-comers, i.e., the pariahs driven there by peoples advancing across regions near the Red Sea

In geological language, when two large areas of rock are displaced, a "shatter belt" develops at the plane of contact. So also in ethnology such a shatter belt survives in the rugged lands along the edge of the main corridor, and is especially illustrated by the tribes of the Caucasus or of California and by those on the western edge of the Brazilian tropical forests

Two other concepts of considerable value in connexion with this method of treating the distribution of man should be mentioned here. In geology, if a new formation is built up around a mass of *older* rock, the latter is called an *Inlier*. Such structures are very common in ethnology. The Basque inlier in North Spain is classic. So also we have a small Neanderthal inlier near Plinlunnon in Wales, according to the researches of Fleure.

No less common is the opposite structure, the *Outlier*. This name is given to an outlying hill of *newer* rock which has been severed by erosion from the parent mass. Such outliers in ethnology will readily spring to mind. Noteworthy examples in Europe are the Bretons in Brittany, the Lapps in Norway, the Magyars of Hungary, and the Wends of Central Germany (*cf.* Fig. 71).

B Language and Nationality

The chief popular criteria of race differences are skin-colour, language, and nationality. None of these is at all satisfactory, in fact, language and nationality have nothing to do with ethnical characters in the strict sense. We sometimes find purely *linguistic* maps erroneously labelled *racial* maps. It is clear that a special term is needed to indicate a *culture group* rather than a *racial stock*. For instance, since the French nation is made up of three races we cannot speak of a French *race*, though French *culture* is readily distinguished. In Canada the culture group of French Canadians might perhaps be described as the "French *cult*," and similarly for other groups linked by a common culture. This is merely extending the use of the word *cult* from a "religious" to a general "cultural" sense.

We can best illustrate the difference between popular and scientific *classification* by a reference to some of the European peoples. Which are the purest races in the sense of biological (or physical) anthropology? Probably the Swiss and Czech. Yet the former speak four

languages in different parts of their small country, three of which are characteristic of very different peoples. From the other point of view, the strains composing French and Italian nations are extraordinarily mingled. In both countries in the west are short, dark long heads (Mediterraneans), next to them are tall, fairer broad heads (Cevenole and Ladin groups) (see Fig. 67). Nationality is usually the result of a more or less harmonious common occupation of a well-defined natural region.³ Given time and goodwill the most diverse races will amalgamate, as the whole history of man demonstrates.

Language is therefore only of secondary value as a criterion. There is much danger in laying too much stress upon it, for it has often been the first characteristic of a group of people which has been scientifically studied. Long before accurate measurements and colour data regarding the Europeans had been obtained, it was realized that there was a close affinity between almost all the languages of Europe, which are classed as Aryan. Later it was found that these languages extended through Persia into Northern and Central India.

It was natural for this similarity of language to sway the ethnologist especially as it agreed to some extent with similarity in skin colour. Looking farther afield we find the Polynesian peoples, who are generally allowed to be allied to the European peoples, yet their languages belong to quite a different group. In the same ethnic family are many American Indians ('Amerinds'), with a type of language differing from almost all those in Europe (except Basque and Abkasian), in that they are polysynthetic. In these languages the expression of a simple sentence takes the form of a single word of unwieldy length.

In Fig. 21, below, I attempt to show what has perhaps happened to the languages of these migrating 'Zones'. On the left is shown a series of peoples spreading out from the centre of evolution in Asia but still in fairly continuous contact. The physical characteristics (which determine race) only alter very slowly, so that we can still trace the common origin of the A group of tribes even when they have penetrated far into the three new regions (see right hand figure). But in those peoples entering America a tendency to polysynthesis perhaps characterized the dominant races at that period and in the course of ages spread generally through the continent. So also in

³The discussion of the relation of environment to nationality forms the subject matter of the recent book by the writer *Environment and Nation* published by the Universities of Toronto and Chicago in 1936.

Europe the higher peoples spoke synthetic languages, ranging from Erse (n_1) to Albanian (c_1), and these obliterated all the languages of the earlier peoples except in the Pyrenees (A_1) and the Caucasus. In Polynesia very little is known of the affinities of the language save that it is akin to the Malay and Melanesian languages, and by analogy one would expect that the two latter are the groups indicated by A_2 and n_2 while Polynesian (and allied Indonesian speech) is represented by c_2 .

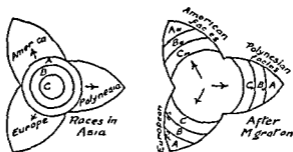


FIGURE 21 —Diagram illustrating the differentiation of cultural characteristics with increasing isolation

Though language is so variable a character, yet it gives us many clues to racial evolution. Indeed, it is possible to show that the same kind of evolution of language is present in each world peninsula. Thus Erse (spoken farthest from Asia) is probably the most primitive Aryan speech, and Sanskrit was first spoken at a much later date. So also the American Indians of the western regions (on the corridor of entry) speak languages of a more advanced type than did the first comers, such as the Iroquois or Eskimo, who lived farthest from Asia. These aspects of the problem will be more fully considered in the sequel.

CHAPTER V

ETHNOLOGICAL CRITERIA

A Colour, Hair, and Stature

Nationality and language, although they appeal forcibly to the layman in classifying peoples, have very little bearing on the problem of physical or biological classification, which is the final court of appeal. The most obvious, but least satisfactory, of these physical criteria is the *colour of the skin*. For scientific purposes this should be judged on the inside of the forearm and not from the face. A pale skin such as that characteristic of northern Europeans is due to a lack of pigment in the lower layers of the skin, while a rosy colour, on the face, is due to the blood showing through the uncoloured skin. Tanning or freckling is due to the formation of pigment in pale skins by the action of the sun. All skin pigment appears to be of the same type. pigment granules are merely more abundant in the skin of the dark than in the skin of the fair races.

Anthropologists are not certain as to the colour of primitive man. Since many dark races are lighter at birth, and lighter on unexposed portions of the body, it is possible that early man was a dark-brown or red brown colour. He was in all probability almost covered with hair, as are one or two of the primitive Negrito tribes found in Central Africa.

The logical explanation of dark skin colour seems to be that it is the result of exposure to the sun's heat. It has often been pointed out, however, that there are some dark peoples (such as Eskimo and Tasmanian tribes) in cool countries, and light coloured tribes in hot countries like North India and Western Brazil. To my mind the difficulty is minimized if we take into account the *time factor*. There is no doubt that a change in the skin coloration would be made permanent only by a very long sojourn in the suitable habitat. There is a good deal of evidence that brunettes survive better in hot climates, and it is thought that blonds ultimately might be weeded out. We know so little of the past history of many peoples that we cannot say if they have occupied their present territory for five thousand or fifty thousand years. If we assume that the dark Tasmanians had only comparatively recently been "pushed" into temperate regions after

spending most of their life history in hot Australia, and that the dark brown Eskimo (originally nearer black?) had only relatively recently occupied the frigid zone after a long sojourn in temperate Asia, then the difficulty of explaining their "disharmonic" colour is much lessened. These, however, are suggestions merely, and cannot be said to be proved.

With a few notable exceptions, we find that there is a fairly close relation between skin-colour and more important criteria like skull-proportions. But we must first clearly realize that really *white* races are numerically unimportant, and so are the really *black* races.

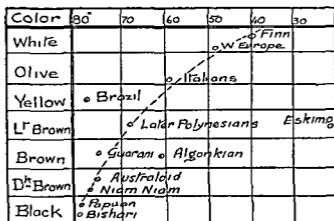


FIGURE 22 — A graph suggesting that skin-colour generally varies with temperature. Note however that the order of the colours is arbitrary. Several exceptions are graphed.

The South Europeans are certainly not white, nor are most of the Negroes black, we may add that none of the Red Indians is red and the Australian Black fellow is chocolate. The logical order in the series of colours would seem to be dark chocolate (occasionally reaching black), dark brown, brown, yellow, olive, olive and white. The intensely dark people are all dwellers in hot countries and are all very dolichocephalic (dokeph) or long headed. In almost every case these dark tribes have lived for untold ages in hot climates and have perhaps hardly varied their climatic environment since their original arrival millennia ago, in the tropics of the Old World.

It is always a good method to chart such data as we are now considering. This is done in Fig. 22, but it must be noticed that our

vertical ordinate (colour) is arranged in an arbitrary fashion. It would be better to give the actual amount of pigmentation, but this is not available. When the various tribes are plotted for skin colour and average temperature, the relation seems to be fairly direct, as shown by the broken line in the figure. However, many tribes, such as the yellow Brazilians or brown Eskimo, do not conform to the general variation. Possibly this is because Nature has not had time in these regions to 'sort out' unfavourable types.

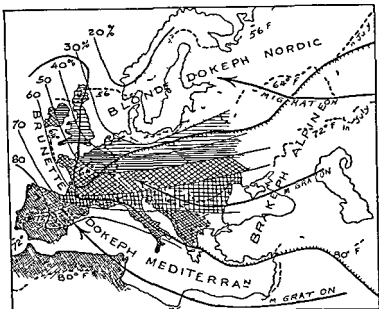


FIGURE 23—The zones of pigmentation in West Europe (After Ripley) Figures show percentages of brunettes. Arrows show migrations. The blond Nordics lived for much of their race history north of July 150 therm 64° F. The Mediterranean brunettes (originally from the same stock in Central Asia) mostly lived south of 80° F.

In Europe, as Fig 23 shows, there is a marked increase in brunetness as we travel south into hotter regions. Here again the map must be considered carefully to see what it indicates. The northern peoples are *blond*, the southern are *brunette*, the central are intermediate in colour. The data become more significant when we realize that many anthropologists believe that the Nordic and Mediterranean races, both of whom have much the same narrow headed (*dokeph*) skull, are varieties of the *same stock*. The writer pictures the Nordics as slowly moving during several millennia from Southern Siberia through

cold latitudes into Europe. We may suppose that in many generations the brunette types died out, for reasons not yet clearly understood, leaving a preponderance of blonds. The other wing of the original group migrated along a hot arid route from Central Asia *via* Arabia and North Africa. During the many millennia involved in this slow migration, the hot climate weeded out the blonds leaving a dark brunette stock, the *Mediterranean* race, to occupy Western Europe.

In addition to skin-colour, eye colour and hair colour are to be observed. The great majority of peoples have dark brown eyes due to pigment scattered through the iris. If there is little pigment, the natural blue grey of the background of the iris dominates. Mixtures of these colours give greenish eyes. The colour of the hair is also dark for most races in the world. It varies through black, dark brown, reddish brown, light brown, blond, golden, and red (light, brick, or auburn). Here again, as in eye colour, the chief variations from the normal dark colour are found in Europe and adjacent regions. Hence these features do not assist us much in determining the major classifications of mankind.

A much more important criterion is found in the texture of the hair. Indeed some ethnologists have based their classification on this feature. We find a wide range of textures with the Negrito at one end and the so called "Mongolian" at the other. L. R. Sullivan¹ uses the following types: spiral tufts (pepper-corn), woolly, frizzy ($\frac{1}{2}$ cm wide, $\frac{1}{2}$ cm deep), curly, deep wave ($2\frac{1}{2} \times 1$ cm), medium wave ($4 \times \frac{1}{2}$), low wave ($5 \times \frac{1}{2}$) and straight. The figures refer to the *width* between adjacent waves and *depth* of each wave.

In ethnology we are dealing with "specimens" of very different sizes and ages. Hence it is usual to record measurements by proportions as well as by actual measurements. These proportions are termed *Indices*. They are used for the skull, hair, eye, nose, and other less important criteria (Fig. 24).

If we examine the cross-section of the hair of various races, we find that it varies from a flattened oval in Negroes to a circular section for Mongolians. To obtain the *Hair index* we assume that the longer diameter is 100 units and then find the shorter diameter, using the same unit (Fig. 26). Thus the index runs from 40 (Negrito) to 80

¹*Essentials of Anthropometry* (American Museum of Natural History, New York, 1923)

(Mongol) In other words it represents the *breadth expressed as a percentage of the length*. This is true of the other indices mentioned. In the eye we obtain the *Orbital index* by making the greater length (across the bony orbit) equal 100 and finding the percentage of the height of the orbit. Here again we find a regular series from Negritos (80), up to Alpine folk (about 92)

		Negrito	Negro	Austr.	Medit ⁿ	Alpine-Mongol
HAIR	Hair Section	40	50	60	70	80
	Color	Black	Black	Black	Brown to Black	Brown to Black
	Wave					
Skull						
Jaw						
Eye						
Nose						
Height		Akka 1400 m.m.	Wolof 1725	1667	English 1700	Krg 1640 hix.
Skin Color		Usually Black	Black to Chocolate	Dark brown to Olive	Light brown to white	Light brown White + yellow

FIGURE 24 — Scheme illustrating variation in ethnological criteria

For the *Nose* we measure the length from the nasion (upper end or root of the nose) to the lower edge of the nasal septum. This is called 100, and the extreme width of the fleshy wings (alae) of the nose is expressed as a percentage. The Negro folk have very broad noses (platyrrhine) with a nasal index of 100. South Europeans and Iberians

often have an index of about 80 (mesorrhine) other Europeans have thin noses (leptorrhine) with an index of about 66 The Alpine Mongolian folk are rather variable from 66 (Galchas of the Pamirs) up to 90 (many Polynesians) but the nasal index varies very considerably even in the same group and among allied peoples especially if there be any mixture with Negro stocks

Stature is rather a variable criterion and differs greatly among closely related people Probably 99 per cent of the world peoples range from 5 feet 1 inch to 5 feet 10 inches But there are some interesting extremes The Akka Negratoes of Central Africa are 137.8 cm high (4 feet 6 inches) while the Galloway Scottish are 179.2 cm (5 feet 11 inches) Almost equally tall are many of the Negroes of Sudan (174 cm) in spite of their unattractive environment The Indians of the Central United States are 174 cm while the Onas of Patagonia are said to be 183 cm high but this is probably an excessive estimate No scheme can bring these diverse tall peoples into the same group for every one of the main divisions (except the Negrito) is here represented *Stature* is probably a feature which reacts *very rapidly* to changing environment Indeed colonial people with their more healthy life almost at once produce taller children than do their kin in the old countries

The short-statured folk however are arranged in an interesting fashion all round the periphery of the world masses (Fig 25) Thus they dwell on the shores of the Arctic Ocean They fringe the south east of Asia and inhabit the East Indian Archipelago and Melanesia They have been driven into the Indian Deccan and the jungles and Kalahari Desert of Africa In Europe we find them in Corsica and the extreme south west In South America they occur in the Brazilian jungles and in the extreme south in Tierra del Fuego (i.e. Yahgan) In part this is due to the unfavourable environments near the Pole or the Equator But it may indicate a widespread primitive Negrito stock which has become merged in the present inhabitants

B The Head Index

The most satisfactory criterion in ethnology in the writer's opinion is based on the *skull-measurement* The most detailed and valuable study of a complex group of peoples is that by W. Z. Ripley entitled *The Races of Europe* Ripley states that the shape of the human head is one of the best available tests of race known (but) its value is imperfectly appreciated He adds further that head form is not

PLATE I



1 — Alp ne Java



2 — Alp ne Tonga



3 — Alpine Salish B C



4 — Nesot T kopia



—Pareoan Sumatra



6 — Mediterranean Maori



7 — Nesot Sumatra



8 — Australoid



9 — Australoid Sakai



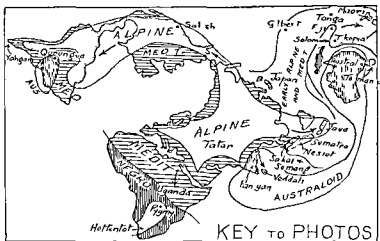
10 — Tasmanian



11 — Semang Perak



12 — Negro Fiji



The position of each tribe illustrated in Plates I and II is inserted so that the reader may see how the zones of allied races are distributed

PLATE II



13—Alpine Tatar Southern Siberia



14—Japanese Dokeph type.



15—Alpine Gilbert Islands



16—Fuegian South America



17—Australoid Veddah Ceylon.



18 Australoid Australia.



19—Bushman South Africa



20—Negrito Ituri R. Africa.



21—Pan van Australoid from Mysore

22—Negro hybrid from Uganda



23—Melanesian Negro from New Ireland.



24—Qurungua Australoid? Bolivia.

very apparent to the layman (or laywoman), and so this criterion does not fall a prey to *artificial selection*. We know that skin-colour, eye-colour, and facial features have altered somewhat among various peoples in the past, according to the change in fashions. For instance, slight figures are more popular among English folk, while plump figures are appreciated among the Southern Europeans (*vide* Klaatsch), and very fat women are attractive to most Negroes. Blonds and brunettes vary in favour. Bearded or smooth skins are popular or unpopular in different parts of the world. If mating is at all generally influenced by some such fashions as these, the unpopular

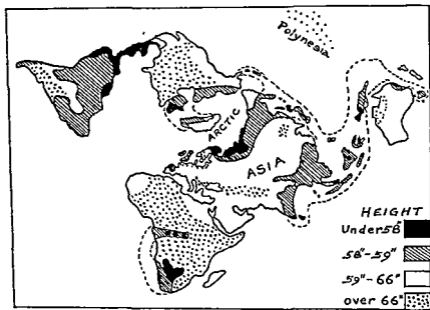


FIGURE 25.—Variation in height. (Based chiefly on Biasutti.)

type tends to die out. The head index (cephalic index) as usually measured is not open to these objections, for it depends on that aspect of the skull which is normally only seen by the aviator!

The cephalic index is the breadth of the skull expressed as a percentage of the length (Fig. 26). The chief point of measurement is *glabella* or centre of the brow (between the eyebrows). The skull-length is measured with callipers between the glabella and the extreme back of the skull, where the point which gives the maximum length is chosen. This length varies from 150 to 210 (or more) mm. The head-breadth is the maximum width in a transverse direction wherever

it occurs. It is usually slightly above and behind the tips of the ears. The width ranges from 125 to 175 mm.

Cephalic index = $\frac{\text{max breadth}}{\text{max length}} \times 100$ Example $\frac{160}{187} \times 100 = 87$

which would represent a normal index for an Alpine.

It is necessary to be familiar with the two chief terms in anthropometry. These refer to the cephalic index. If the breadth is less than 80 per cent of the length the head is dolichocephalic, if it is over 80 per cent of the length the head is brachycephalic.² Notice that high figures in this index (80-97) mean *broad* heads while low figures (65-80) mean *narrow or long* heads. It is a measure of BREADTH in reality, but heads which differ very considerably in their absolute length may have the same *relative* breadth.

Unfortunately there is a distinct tendency today to depreciate the value of the head index as a racial criterion. This is in large part due to the research of Boas³ on the changes which the children of European immigrants experience if they are born in the city of New York. He deduced that the head breadth of the brachyceph Jewish children decreases and that the head breadth of the dolichoceph Neapolitan children increases with the change of birth place. But it is not so clearly realized how slight is the alleged change—what factors have produced the change—and finally that Boas himself issues a cautionary statement with his findings.

The average decrease in head width in Hebrews merely amounts to 1.52 mm which is just one per cent of the absolute width. (This would hardly affect the cephalic index by one unit.) In the case of the Neapolitans the increase is 0.48 mm—and the change (in some 140 mm) is still slighter. Moreover, Boas very properly points out that certain measurements of the parent immigrants (such as width of head and width of face) varied steadily from 1880 to 1910, and this variation certainly affects the importance of the change in their progeny born in New York. Moreover, the writer would like to be sure that the age factor does not enter into the problem. There is usually a slight change in the head index as a child grows up—quite independent of his race. Venn (1889) showed this years ago for

²These are such ponderous terms and occur so frequently that I have for many years used the contractions *dolichoceph* for narrow heads and *brachyceph* for broad heads.

³*Changes in Bodily Form* (Washington 1911)

undergraduates at Cambridge (England) Here there was an increase from 77.9 to 79.2 during the period from 19 to 23 years old On the other hand, A Macalister (1897) states that there is in general a change toward brachycephaly as the child grows up Since Boas is mainly dealing with young subjects (from birth to 25), this is a vital point

A second point is that a mere change of life from country to city (e.g., in Italy) has considerable effect on physical measurements, as Livi has proved To this also Boas refers, and allows that it may have a bearing on his investigation His conclusion is very important "The proof of plasticity of types does not imply that the plasticity is unlimited The history of British types in North America, of the Dutch in the East Indies and of the Spanish in South America favors the assumption of a *strictly limited plasticity*"

In 1913 Boas discussed the conditions which arise in Central Italy where the Alpine and Mediterranean races have been in contact for several thousand years He plots the mean square variability of the cephalic index, and shows that there has been not enough merging even here to invalidate the use of the cephalic index as a race measurer.

The present writer feels that the slight non continuous variations noted by Boas do not affect the validity of the cephalic index How else can we account for the relative uniformity of the Alpine race (inhabiting high plateaux, hot plains, salty steppes, deserts, wet mountains, marshes, and fertile lowlands) which extends from the Himalayas to the Bay of Biscay? As Ripley (1900) writes "The Galchas, Tadjiks and their fellows (of the Pamirs) are grey eyed, dark haired, stocky in build, with cephalic indices ranging above 86 for the most part From this region a long chain of peoples of similar type extends uninterruptedly westward over Asia Minor and into Europe"

Many British anthropologists have been sceptical of these remarkable variations discovered by Boas Since the above criticisms were written, Morant and Samson have subjected his statistics to careful analysis, and in June, 1936, published their findings in *Biometrika* They conclude that "considerably larger divergences would have to be found in order to establish the fact that head form is directly modified by environment Boas' theory cannot be upheld"

The chief difference between man and the lower animals is in the development of the reasoning faculties This is correlated with a growth of brain, which takes place chiefly at the sides and top of

the organ. Thus as the reasoning powers become of greater value (as man evolves) and the power of the jaw of less importance we can see that the sides of the skull would tend to bulge out and the front of the skull tend to become less prominent. W D Wallis points out that man's upright position leads to a decrease in the occipital muscles and so to a broadening of the skull.⁴ At any rate with the exception of the very small and aberrant group of Negritos we can show a continuous series of measurements leading from the primitive Negro (69) up through the Iberian (75) group (the Mediterranean etc) and West Europeans to the Alpine (85) and the Mongolian peoples (who have much in common). The various diagrams in Fig 24 show that this order in these races is true of hair section hair colour hair texture orbital index nasal index jaw shape (prognathism) and cephalic index. Skin colour is fairly in accord and indeed stature is the sole criterion which does not agree at all. As we shall see this seriation from Negro to Alpine is in accord with the zones of distribution and is supported by a host of culture facts and customs which have been spread abroad (in unison with the migration zones) from the original centre of dispersion.

The development of every individual recalls to a certain extent the evolution of the race. In the earliest embryo stage he shows traces of his fish like ancestor (i.e. in the gill-slits). The lanugo or woolly covering of the foetus indicates a stage when his ancestor was furred like the monkey. The new born babe resembles somewhat the pithecoïd ancestor from which both apes and man descended. Then as he grows older there is a tendency to change from the primitive type of skull to the later type.

Human palaeontology supports the view that the broad skull is a later development than the long skull. The primitive skulls from Java Rhodesia Piltdown etc are all long heads moreover they have a small *brain capacity*. Here again there is a general progression in living races from the low brain capacity of the Negro through the medium brain-contents of Mediterranean skulls to the largest capacity shown by the Europeans and Chinese indeed Clapham declares that the Chinese (i.e. Alpine) brain is larger than that of the Western European.⁵

⁴American Naturalist 1925 p 68

⁵C Clapham Brain weight of Chinese (*Journal of the Anthropological Institute*, 1878 p 89)

C Classification of Races

Before closing this section dealing with criteria, it is important that students should understand the great importance of a scientific nomenclature. Unfortunately we cannot say that ethnology possesses this yet. For instance, little progress was made in the ethnology of Europe as long as the term "European" was used as an ethnological division. There are now recognized at least three different types in Europe—the Mediterranean, Nordic, and Alpine. Almost every other region of equal area has as diverse a series of peoples. The name *Chinese* will have to be dropped as a race-name since it includes the varied races of South China as well as the more homogeneous North Chinese. For instance, in the East Indian Islands there is a growing tendency to use *Nesiot* for the earlier migration (akin to Mediterranean) and *Pareo ean* for the later folk akin to the Alpines.

The American Indians belong to many categories, whether we use colour, language, or skull measurement as criteria. Even the hair, though usually straight, is found to be wavy and even frizzy in certain parts of the continent. The Polynesian and Melanesian peoples are equally heterogeneous. It is perfectly absurd to link the primitive peoples of New Caledonia with the highly advanced Massim of the Solomon Islands. Naturally no progress is made in classifications as long as these principles are not fully understood.

In 1919 the writer published a classification of human races which departed in a number of respects from current classifications. His chief interest in science for the past fifteen years has been in the early history of the human races, especially in their differentiation and migration, and he is now even more sure in his belief that the somewhat new tools and methods then employed, if adopted more generally, would in considerable measure modify current classifications.

Two quotations from authoritative books will emphasize his point of view. Kroeber writes "The only classification that can claim to rest upon a true or natural basis is one which takes into consideration as many traits as possible and weights the more important more heavily than the unimportant features"⁶ The present writer would like to see included under the word "traits" such factors as ecological distribution and archeological strata. Another pertinent quotation is from E. B. Tylor, as follows "The classification by Cuvier [about 1820] into Caucasian, Mongol and Negro corresponds in some measure with a division by mere complexion into white, yellow and black

⁶Kroeber, *Anthropology* (London, 1935)

racés but cannot be regarded as separating the human types either justly or sufficiently ' 7

Strangely enough, the classification of Cuvier, made before anthropology was a science, still seems to be the basis of most modern classifications. It is surely unusual for pre scientific classifications to remain orthodox for so long a period, and the present writer has been completely unorthodox in this respect ever since he commenced his research in anthropology.

We may profitably consider the various classifications which have been suggested in the past (see the table on pp 61 5). The basis of the early classifications was skin colour. Then the value of the hair was appreciated 8. The nasal index was the basis of Topinard's second classification. Deniker combined colour and nasal index. Of recent years skull characters are becoming of more importance. I have mentioned that Ripley used them combined with the facts of distribution and environment. This is the plan which appeals to the writer, and is the basis of his scheme published in 1919. It may be named the 'Migration zone' scheme of Classification, and is correlated with the order of evolution. In 1922 Dixon, in *The Racial History of Man* has used skull measurements and has produced a classification very like my own. He stresses the height of the skull somewhat, but does not use the geographical distribution as a factor in his classification. Haddon in 1924, in his *Races of Man*, has made hair the chief basis of classification, and has combined this with skin colour, stature, and head form.

A reference to the table (pp 64 5) will show that there are certain fairly harmonious combinations which to a certain extent justify the old classification by colour. These are

- I Very long headed folk, broad nosed, nearly all have dark skins, frizzy hair, and live in the tropics (*Negritoes and Negroes*)
- II Broad headed folk, nearly all have white to light brown skins, wavy or straight hair, and live in temperate lands (*Alpine*)
- III Most moderately dolichocephalic folk have brown to white skins, thin noses and wavy hair. They have no very definite climatic environment but range throughout the tropical and temperate regions. It is this great range of migration which has prevented their common origin and real physical similarity from being recognized. On the other hand they invariably occupy a somewhat peripheral position outside group II and within group I, and are *Mediterranean*.

⁷In the article on Anthropology in the *Encyclopedia Britannica*

⁸See T. Huxley 'Geographical Distribution of Mankind' (*Journal of the Ethnological Society of London* 1870) and P. Topinard *Anthropology* (London, 1890)

These main criteria of head index and hair are charted in Fig. 26.

It is clear that there is a close resemblance in the zones of the two maps. In the sequel it will be found that the evidence indicates that there are three main races, Alpine, Mediterranean, and Negro; and three less important races, Nordic, Australoid, and Negrito.

The classification which I proposed, incorporated certain suggestions which have been put forward before. We see that St. Hilaire grouped some of the Amerinds with European folk, while Deniker linked Palaeo-Amerinds (i e, the first migrants into America) with the Mediterranean race.

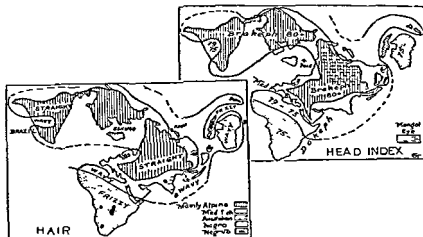


FIGURE 26.—The distribution of head index and of hair. These are the most important ethnological criteria, and separate man into the five races shown in the left hand map

Dixon (1922) has followed my classes (of 1919) in grouping Eskimo near the Negroid races, and Alpines with those Mongols and Amerinds who live in the Corridor of Migration.

The greatest difficulty is to place the Negrito. I think the evidence indicates an entirely separate stock for the brachycephalic Negrito (Aeta, Mincopi, etc.). There seems to me no good reason why there should not have been two pithecoïd stocks in Asia in Pliocene times which gave rise to permanent races. It has been suggested that the Negrito preserves some of the characteristics of the human foetus, and this strengthens the theory that the Negrito is the earliest race.

Most zoologists believe that there were a number of primitive "ape-men" like Eoanthropus and Pithecanthropus, although these

GENERALIZED TABLE SHOWING VARIOUS ETHNOLOGICAL CLASSIFICATIONS*

<i>Date</i>	<i>Author and basis</i>	<i>A Largely so-called "yellow"</i>	<i>B Largely "white" or "brown"</i>	<i>C Largely "black"</i>	<i>D Other groups</i>
1860	Saint Hilaire (skin-colour)	Mongolian including Eskimo Australian	Caucasian including tribes of Alleghanies	Ethiopian	Hottentot
1870	Huxley (colour)	Mongoloid, including Polynesian Amerind Eskimo Malay	A Xanthochroid (Nordic) B Melanochroid (Iberian)	Negroid	Australoid, including Dravidian Ethiopian
1878	Topinard (hair)	<i>Straight haired</i> Mongols Eskimo Amerinds	<i>Wavy or frizzy</i> Europeans Semites Australians Turanians	<i>Woolly-haired</i> Negroes Negritoes	
1885	Topinard (nose)	<i>Yellow and Mesothic</i> Eskimo Mongols S. Amerind (some)	<i>White and Leptothic</i> Europeans Semites	<i>Black and Platythic</i> Negroes Australians Negritoes	

1900 <i>circa</i>	Deniker (hair, etc.)	Straight hair Mongol Eskimo Amerind	Wavy hair Blond N Europe	Brunette Iberian Polynesian Palaeo- Amerind	Woolly and Platyrrhine Negro Negrito Melanesian	Curly or wavy Ethiopian Australian Dravidian Assyroid
1919	Migration Zones and Strata Classification (Griffith Taylor)	Brachycephalic, Central Zone (Latest) West Alpine Centre East Chinese Many Polynesians and "Corridor" Amerinds	Moderately Dolichocephalic, Intermediate Zones West W Europe Mediteranean and North Indian	East Malay N Melanesian Ainu Many Amerinds Eskimo	Very Dolichocephalic, Peripheral Zone West Negro South East Some Palaeo-Amerinds	Brachycephalic Dwarfs Inaccessible Jungles, etc (Earliest) West Negrito East Central S Asia Africa
1923	Cranial breadth and height (Dixon)	Alpine (high) Ural (low) Central Europe, Centre and E. Asia, West of America, Polynesia, etc	Caspian (high) Mediterranean (low) N and S Europe, Arabia, Japan, N Africa, Brazil, etc	Proto-Negroid Proto-Australoid West Europe Africa, Australia, S India, New England (US), Brazil, etc	Palae Alpine Mongolian (largely dwarf stocks)	

perished without having any modern representatives. This variety would seem to me to be an argument in favour of polygenesis. I venture to suggest therefore that the living races are descended from *two stocks which are equally important in this connexion*. These are (A) The forerunner of the brachycephalic Negrito (Aetas, etc.) and (B) The forerunner of the Negro etc. From this latter forerunner all modern races are derived, except the Negritos (Fig. 101).

This aspect of the problem is discussed more fully in Chapter XXI.

D The Ethnograph

In a number of other branches of geographical research, such as climatology and economics, I have found it very helpful to use graphic methods for comparing numerous types (Fig. 27). Such graphs tend

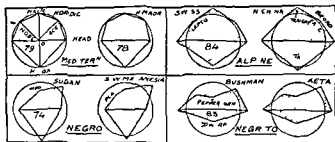


FIGURE 27.—Ethnographs of four races. Radial distances indicate characters using Nordic type (in circle) as criterion. Not so close resemblance (in five major racial characters) of the very distant types (e.g. English and Maori) compared.

to diminish the personal equation and they enable conclusions to be drawn much more readily than do tables of figures. I have therefore devised an *Ethnograph* in which the five chief criteria of race are graphically represented. Since in my opinion cephalic index is the best single test of race, I have used this as the chief measurement in my graph. Furthermore, in order to make every race readily comparable with the type best known to my readers, I have so arranged matters that the unit of each criterion is that which is present in the typical Anglo-Saxon (Nordic) of East England.

The ethnograph is a six-sided figure where the east-west axis corresponds to the value of the *cephalic index* (e.g. 79 for the Nordic variety of the Mediterranean race). From centre to top is the measure

of *hair type* From centre to bottom is the measure of *stature* From centre to north west is the measure of the *nasal index* From centre to north east indicates the *face breadth*

Drawing a circle, as illustrated I consider that the hexagon which fits within the circle represents the Nordic type Races with broader heads or straighter hair or broader faces or greater stature have correspondingly longer axes as is the case with the Alpine Races with narrower heads frizzy hair, platyrrhine noses, and shorter stature have correspondingly shorter axes, as is the case with the Negrito In later illustrations, ethnographs for Europe, Africa, and America will be found

These ethnographs illustrate difficulties which most anthropologists seem to have ignored How can one explain the close resemblance (in five specific criteria) between such far distant types as are here graphed? Nordic and Northern Maori are much alike, in spite of their habitats being antipodes Swiss and North Chinese, Sudanese and Northern Melanesian, Bushmen of South Africa and Aeta of the Philippines the units of each are akin Only the spreading of racial zones from a *common cradle land* (roughly half way between the two) can possibly explain these biological affinities (Fig 101)

E Human Origins

A recent book with the above title has recently been published by the Department of Anthropology (Chicago University, 1945) It includes twenty five chapters by well known authors Of these the sections dealing with *Mount Carmel Man*—linking Neandertal Man to modern types (by McCown and Keith) *Racial Zones* (by Griffith Taylor) *Racial Types* (Sir Arthur Keith) *Climatic Effects in the Tropics* (C A Mills) and *Civilization in South America* (E Nordenskjöld), will all be found of much interest to the readers of this volume

PART II

THE CHANGING ENVIRONMENT AND
PAST RACIAL DISTRIBUTION

CHAPTER VI

THE CHANGING ENVIRONMENT IN THE AUSTRALASIAN "PENINSULA"

A Topography

We have seen that the dominant features in the structure of this portion of the world are the *ancient shield* of Western Australia, and the highly mobile belt flanking it to the east running from Malaya through the East Indies and Melanesia to New Zealand. Research in this great region is naturally not so detailed as in the European or American areas, but enough evidence has accumulated to show that changes in the topography have here affected man's environment perhaps to a larger extent than elsewhere. Nowhere else do we see such enormous submerged lands as in the Sunda and Sahul regions (Fig 28). Nowhere else are recently elevated shore lines better exhibited than in these coral girdled islands (such as Kambing) which I have seen to the north and north-east of Australia. Nowhere else has isolation affected a people for so long a period as in Australia and Tasmania. In this region, moreover, are many of the most interesting primitive peoples as well as human relics such as the Trinil and Talgai skulls. Here also is the habitat of the oranges and gibbons.

Let us glance at the wonderful series of earth folds which characterizes so much of this region. They commence at the south east corner of the Tibetan Plateau. Here are six parallel ranges separated by deep river valleys within a distance of four hundred miles (Fig 36). These valleys are unique in that each is occupied by a river which maintains its course to the sea without joining any of the others. Running from east to west these six head waters are the Hoang Ho, Yangtse, Mekong, Salween, Irrawadi, and Brahmaputra. Such an "uneconomical" drainage scheme can date back only to yesterday, and, indeed, it is the direct result of the mountain folding which resulted when the Himalayas were built up. Associated with this is the volcanic action off the mouth of the Irrawadi.

As a result of these comparatively recent bucklings we find a well marked division separating the peoples to east and west of this line. Indeed, the Indo-European peoples who speak Aryan tongues reach no further east than the Brahmaputra. Beyond is the great area marked by Chinese culture.

Passing to the east these bucklings are continued in the elongate islands of the East Indies to New Guinea. We obtain a better picture of the topography if we consult a block diagram of the region, where the sea bottom is shown as if the waters were drained away (see Fig 28). The ridges constituting Sumatra, Java, etc. are seen to be perched on the edge of a huge drowned area, Sunda Land, which rivals the whole of India in extent. Much of the sea between Java and Borneo is less than 200 feet deep. So shallow is it that the

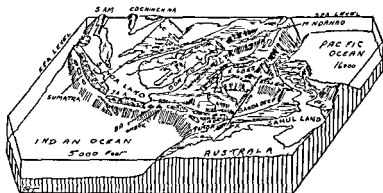


FIGURE 28—Block-diagram of the sea floor in the East Indies—showing the Stepping Stones to Australia. During the Ice Ages the seas were about 200 feet lower—exposing Sunda Land and Sahul Land so that Timor to X was only 100 miles. The two continents were then only 600 miles apart instead of 2 140 miles. Weber's Line is the chief biological break. (Depths from Molengraaf.)

channels of buried rivers can be made out which once drained Sunda Land to the north-east. The heads of these rivers are still preserved in West Borneo and Sumatra and contain the same kinds of fresh water fish while the fish of East Borneo are quite different¹. This absence of variation in the species shows how recent the drowning must be.

Sunda Land extends as far as Lombok and the Macassar Strait. Then comes the Banda Deep separating it from the ancient Sahul Land which once connected Australia to New Guinea. This also is drowned by about 200 feet of water so that an area about twice the size of Texas (or France together with Britain) has been lost here in

¹See F. Molengraaf, *Modern Deep-Sea Research in the East Indian Archipelago* (*Geographical Journal* Feb. 1921).

recent geological time. All round the margin of the Banda Deep is a broad rim of land, submerged about 1,000 feet, on which are perched the Islands of Bali, Timor, Ceram, Celebes etc. It is generally held that these two large areas, Sunda Land and Sahul Land, were above sea level during the last of the Ice Ages. The melting of the ice consequent on the change of climate has produced an enormous amount of water, which before was locked up on the lands. This influx of waters has led to that drowning of the coasts of the world, to a depth of about 180 feet, which is so marked a feature in almost all areas where it has not been counterbalanced by recent uplift.

We thus see that during the Great Ice Ages an influx of primitive folk into Australia would have been much easier than today. Between Timor and Australia is now about 350 miles, but from Timor to the ancient Sahul Land was only 100 miles. So also in those days there was no gap larger than sixty miles along the northern rim from Borneo *via* Celebes and the Moluccas to New Guinea and Australia. We know that there never was a *complete* land connexion, for none of the Asiatic mammals has reached Australia except the dingo and rat, which probably came with man. "Weber's Lane," which separates the major Asiatic animals from Australian animals, runs from Eastern Timor to Western Jilolo. This has been a *water* barrier for many millions of years.

It is important to note that the Tasmanian aboriginal presumably crossed before the Australian, and he also must have had some sort of raft for the same reasons. One can picture these primitive folk wandering from Asia into Sunda Land and then retreating slowly before the influx of more advanced tribes. Finally, when their hunting grounds are completely overrun, they despairingly put to sea in their rough rafts made of bark or bundles of rushes. Many are lost, but some few reach the islands to the east, whence they ultimately enter Australia.

Two factors preserved them when they reached the Australian continent. We may reasonably suppose that soon afterwards Sunda and Sahul Lands were drowned by the melting of the ice-caps in a later Interglacial Age (see p. 99), thus greatly diminishing the risk of attack, and secondly the climatic conditions in the north of Australia certainly did not attract any peoples who were not driven there by dire necessity. We shall consider this aspect later.

The great folding forces swept round the eastern side of Australia, buckling up New Guinea to heights of 16,000 feet (in the Dutch

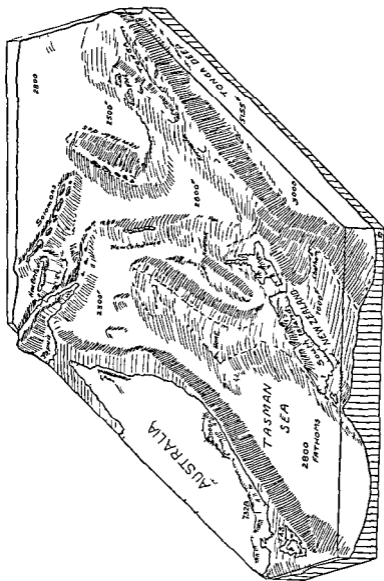


FIGURE 29—The warped floor of the south west Pacific. Depths are in fathoms heights in feet

region) Many successive earthquakes may have accompanied this buckling for Rawlings speaks of a fault face 10 000 feet high near Mount Cartensz² The flanks of the uplift are covered with active or recently active volcanoes and raised coral reefs are common features all along the coasts

In the south west Pacific there are four major buckles which are indicated in the accompanying block diagram (Fig 29) On the east is the Tongan Deep with a maximum depth of 5 155 fathoms (30 930 feet) which extends more or less continuously from Samoa to Chatham Island 2 400 miles to the south Here is the engine (according to Hobbs) which has caused the crustal deformation Thrusts to the west have caused an enormous ridge from 18 000 to 30 000 feet high to develop which reaches above the sea in the Samoa Tonga Ker-madec and Chatham Isles The next ridge rises about 8 000 feet and carries the New Caledonia group The next appears at the surface only in Lord Howe Island These three unite to the south in a broad submarine plateau on which rises New Zealand to a height of 12 300 feet above the sea Then there is a fairly deep trough and the Australian highlands flank the continent rising to 7 000 feet above the sea

We do not know much about the age of these uplifts save that the whole region is still very active with many volcanoes especially in the New Hebrides Tonga and New Zealand Mawson³ and others have shown that the western festoon islands (New Hebrides etc) seem to have undergone continuous upheaval for they are veneered with coral reefs of very recent growth The Fiji region seems to have been elevated and then to have subsided many times in fairly recent geological time while the islands farther to the east (e g Funafuti) are coral atolls which denote that subsidence dominates the movement

Turning to the mainland the buckling is insignificant compared with that shown nearer the deeps The wave-depth changes from 30 000 feet to 5 000 feet (see Fig 29) This certainly supports the theory that the folding pressure comes from the east rather than from the solid shield in the west

The chief elevated region in Australia is confined to the east coast where the earth buckles connected with these waves moving from the Tongan Deep have raised a broad ridge about 100 miles wide and

¹Dav d Papua (*Federal Handbook* British Assoc at on 1914 p 321)

²D Mawson New Hebrides (*Proceedings of the Linnæan Society of New South Wales* 1907)

running approximately north and south. This elevated portion consists of a series of fault blocks of which the highest reaches 7 328 feet at Kosciusko (Fig 30). Several other blocks attain 5 000 feet such as New England Bimberi Mount Bogong etc. Relatively lower blocks have determined the course of the rivers such as those flowing north or south in Victoria, and the Upper Murrumbidgee Tumut and Snowy Rivers.



FIGURE 30—Drainage in south-east Australia showing changes in the rivers due to late Tertiary warping. Inset on the left are two vertical sections through Orroroo in the Flinders Horst.

The drainage system is of recent origin, hardly a river on the eastern side of the Great Divide flows normally to the sea. Reversals, boat hook bends (in tributaries), alternating senile plains and juvenile gorges are characteristic of these eastern rivers. For instance the Nepean River flows in meanders through a deeply alluviated plain for many miles. It then enters the buckled region of the Blue Plateau Warp near Mulgoa and for ten miles occupies a gorge up to 700 feet deep. It leaves the warp near Penrith and enters another alluviated plain which was probably at one time a warp lake fifteen miles long. In its course it describes a crescent all round the plains just west of Sydney.

Other late movements have cut off the head of Yass River, forming a fault scarp 250 feet high. At the foot of this scarp is Lake George, about twenty miles long and six miles wide which has no outlet. From the silts deposited in the lake it is possible to estimate in a vague fashion the age of the faulting. Possibly about 20 000 years ago is as near as we can get to the date.⁴

⁴See *Proceedings of the Linnean Society of New South Wales* 1907 p 339

The most striking example illustrating the recency of the warping is found in South Australia. Here is a fourth wave in the series between the Tasman Sea and the West Australian Shield. It constitutes the Flinders Range which seems to have been elevated as a fault block (or *horst*) rather than as a warp. Howchin⁵ shows that originally the Siccus River flowed from Lake Frome to the gulfs at Wakefield (Fig 30). The warping dammed back Lake Frome and elevated the Siccus gravels to a height of nearly 2 000 feet at Orroroo on the top of the uplift. Here these gravels are found as a deposit 600 feet deep. The presence of these *elevated, loose* gravels clearly indicates the recency of the warp—since only a short period is enough for erosion to sweep away such material (see Inset in Fig 30).

The greater part of the mainland has not been below the sea in late geological time. The chief area won from the sea is at the mouth of the Murray, where a long tongue of late Tertiary formations speaks of a former gulf akin to the depressed blocks (or *Graben*) drowned to the west of Adelaide (Fig 30). But much land has been lost to Australia along the east and south coasts, as is shown among other evidence by the presence of river divides right on the east coast (e.g., Cairns, Bulli, etc.). The evolution of Bass Strait is not clearly understood. There is no need to invoke dry land for the Tasmanians to reach their island for they certainly had no bridge across the gap west of Papua. Further the fauna seems to indicate complete separation from Australia since man appeared, or else we should expect the *dingo* to have crossed. However, the "tiger" and "devil" have only recently died out in Australia, though numerous in Tasmania so that Tasmania was probably connected during most of Tertiary time.

Evidence of drowning to the extent of one or two hundred feet is universal, and may be logically set down to the melting of the Pleistocene ice caps. The Bass Straits are crossed by two ridges, still apparent in Flinders and King Islands (Fig 30). But the straits are much deeper than the Torres Straits. However, Hedley has shown that the eastern and western marine shells have not yet had time to mingle completely by way of the straits so that we may assume Pliocene times as about the date when the island was last severed from Australia (see, however Chapter VII, *postea*).

Speaking generally, Australia is a low plateau about 1 000 feet above sea level. Only about 5 per cent is above 2 000 feet in elevation.

⁵W Howchin in *Report of the Australasian Association for the Advancement of Science*, vol XIV 1913 p 169

Tasmania is a somewhat hilly area since rather more than half exceeds 1 000 feet. This is due to its being merely an isolated portion of the Cordillera. Indeed these rather rugged Eastern Highlands are the chief economic regions in Australia since here alone is there an abundant rainfall with a temperate climate.

The rest of the continent consists in part of the lowlands of the Murray Basin and the Lake Eyre Basins. These have experienced some subsidence and much filling by river alluvials in the last geological epoch. Lake Eyre is a salt lake or *playa*, with its shore 39 feet below sea level. It is a vast expanse of salty mud without water.⁴ The remainder of the continent is the West Australian Shield almost all very arid country and covered largely with desert 'waste dunes laterite etc. This is described in greater detail in Part III Chapters XXVII and XXVIII.

B The Changing Climate

In the preceding section the changing topography has been discussed. We are unable to assert that man occupied Australasia during all these changes. But Dubois believes that men akin to the Australians lived in Java during the Pleistocene⁷ so that man may have witnessed much of the warping referred to previously. As regards the changes in climatic conditions we are on surer ground and the evidence is much more abundant.

Australian climates depend essentially on the latitude. No other continent has so large a proportion of its area in the Trade Wind Belt and consequently no other has relatively so much of its extent desert. From the point of view of changing climates we are to picture Australia as crossed by a broad belt of arid climate which swings north and south with changing *temperatures*. Normally this swing of temperature results from the swing of the sun from tropic to tropic about 3 200 miles. The rainfall belts swing in unison but five weeks later. This is clearly shown in the Solar Control Model which I have published elsewhere.⁸

Thus the centre of the Trade Wind desert also swings with the temperature and it can be plotted month by month. This centre of aridity lies over Pine Creek (lat 14°) in July and over Tarcoola (lat 29° 30') in January. It therefore swings through 15½ degrees each

⁴C. T. Madigan *Central Australia* (London 1935)

⁷Man of Wadjak (*Proceedings of the Royal Academy Amsterdam* 1921)

⁸Frontispiece to *Australian Meteorology* (Oxford 1920)

six months Putting this another way, we see that when Australia is hottest (January) the desert conditions reach to the south coast. When Australia is coldest, they reach practically to the north coast. Luckily the Tropical Rain Belt covers northern Australia in summer, while the Polar Rain Belt covers southern Australia in winter. Hence only the central portion suffers from desert conditions all the year round

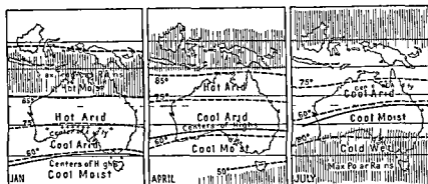


FIGURE 31—January April and July climates in Australia (a) Present summer and like Pliocene Equinox (b) present Equinox and like Pleistocene summer (c) present winter and like Pleistocene Equinox In the Pleistocene winter the rain belts were probably still further north

Let us now see the effect of changing the temperatures. If the land be subjected to cooler temperatures, this is equivalent to increasing the factors which bring the *southern* rain belt to Australia. We should expect a strengthening of this rain belt so that it became broader, in effect, the desert would retreat to the north. If the climate as a whole became hotter we should expect a southward movement of the desert and a deterioration in the living conditions of southern Australia. We shall show that this deterioration has occurred in the latest geological epoch.

In the adjoining illustrations (Fig 31), I attempt to show how the changes in temperature affect the rain belts, not only under present conditions, but also under conditions somewhat hotter (Pliocene) and colder (Pleistocene) than at present.⁹

The centre of aridity, under present conditions, agrees approximately with a temperature of 75° F. The Tropical Wet Belt reaches down to about isotherm 85° F, and the Polar Wet Belt reaches north

⁹See Griffith Taylor, "Climatic Cycles and Evolution" (*American Geographical Review*, Dec 1919 p 292)

to about isotherm 55° F. If now we postulate an epoch like the *Pleistocene*, when the snow line moved down 2,000 feet on Mount Kosciusko, we may assume a temperature some 6° F cooler. This 6° of vertical cooling is equivalent to about 400 miles of *horizontal* movement, for we must move 70 miles (or one degree of latitude) to experience one degree diminution of temperature. Thus the Pleistocene winter probably showed moist conditions about 400 miles north of where they are today (Fig 31 at C)

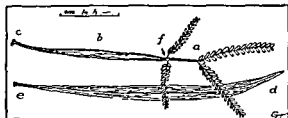


FIGURE 32—The change in leaf form in some Australian acacias illustrating past change of climate. The first leaves of the seedling are bipinnate like the portion *fa*. The second stage of leaf is like *ea*, then the stalk broadens and the final leaves are all phyllodes like *ed*.

The evidence of wetter conditions in southern Australia in recent geological times is very strong. Thus we find botanical "outhers" as moisture loving plants far in the desert. *Flindersia* is allied to the tropical teaks, and several species occur in the coastal rain forests. But one species—the "Leopard Wood"—is found throughout the arid Darling Basin where the rainfall is only 10 inches. Like a number of acacias it changes its habit with age, as E. C. Andrews points out, for its trunk (which grows to a height of 20 feet) is surrounded by a dense brambly growth when young, which it drops off as the tree reaches maturity. Thus an early *humid* habitat, followed by an *arid*, and then by a *less dry* environment, is indicated. Nearly all the inland acacias do not possess true leaves but the flattened stalk (or phyllode) acts as the leaf. These species "recapitulate" the evolution of the plant during their early growth. When it is a seedling, the acacia has ordinary bipinnate leaves, but gradually the leaves change to phyllodes. The intermediate leaves are very interesting, showing clearly the response of the plant to the change from a moist climate to an arid climate, where phyllodes conserve the plant's moisture better (see Fig 32).

We may now turn to the physiographic evidence which is equally

clear All through southern Australia are dwindling rivers, losing their way in silts which not long ago formed no barrier to them Every inland river now ceases to flow not even excepting the Murray, which has dried in its lower courses three times in the last century The Darling is often dry for eighteen months at a time The Lachlan and Murrumbidgee usually reach the Murray, but a dry spell stops their flow The Victorian tributaries, such as the Wimmera, lose themselves in sand dunes, which now extend for nearly 100 miles between the Wimmera and the Murray Further west in South Australia the river valleys have been dammed by dunes and silt so that meandering salt lakes or *playas* are formed, as at Lake Labyrinth near Kingoonya These salt lakes are characteristic of southern West Australia, and hundreds of them occur in the goldfield region Their growth is due to a peculiar form of arid erosion consequent on the desiccation of the continent to the south of the Trade Wind desert Penck has described similar evidences of desiccation as universal in the other continents in the same latitudes, i e from 25° to 30°

Even in those regions where the rainfall is still adequate, there seems little doubt that it was once much heavier In fact, there seems some evidence of several pluvial cycles If we examine the caves at Jenolan (80 miles west of Sydney) we find that they are cut in an almost vertical bed of limestone which runs across the Jenolan River Valley This deep juvenile valley was eroded in response to a rise of some 3 000 feet when the Blue Plateau was formed probably in early Pleistocene times The homogeneous bar of limestone has been eroded into several large caves at each of *three distinct levels* These levels are connected by narrow, more or less vertical, channels The simplest explanation is that the large caves were cut during the pluvial cycles, and the narrow vertical channels during the drier cycles (We cannot, of course, be sure that periods of *slower* uplift were not also factors in the differential erosion)

C *Ice Ages in Australia*

The most striking evidence, however, is found in the records of the Pleistocene Ice Age, which are becoming more numerous as the highland areas in the south are carefully investigated Throughout Tasmania the higher regions exhibit cirques glacial lakes, erratics and moraines which have been described by J W Gregory, N Benson, A S Lewis, and others (Fig 33) At the Tasmanian National Park (Mount Field) the writer has investigated the cirques, and there

seems to be evidence of two cycles of ice erosion at least. The plateau is at a level of 4 000 feet and is drained by the Broad River. Three or four terminal moraines across this valley show resting stages of a glacier which extended some five miles from the summit at its maximum. Possibly also in this cycle the large cirque occupied by Lake Seal was cut out to a depth of 1 000 feet, the floor being not much

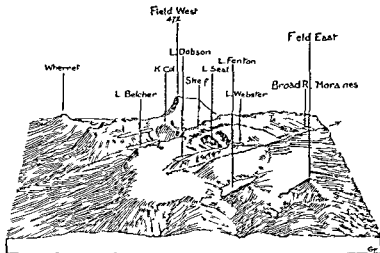


FIGURE 33—Glacial features on Mount Field Plateau 50 miles west of Hobart, Tasmania. The plateau is seven miles across.

above the Broad Valley Glacier. The other cycle is marked by a curious rock shelf about 400 yards wide carrying seven tarns which drain *along* the shelf as well as over the edge and down to Lake Seal. This shelf is at the 4 300 foot level and was cut out, I imagine, during the last cycle when the zone of maximum erosion (by sapping) occurred at this level. This zone (which is that marked by the strongest thaw and freeze action) necessarily accompanies a temperature of about 32° F. It now lies about 1 500 feet above the Mount Field Plateau.¹⁰

The Kosciusko evidence is perhaps shown most clearly in a sketch diagram (Fig. 34). This is based on a contour survey carried out in 1921 by Dr. W. Browne, Mr. Jardine, and the writer.¹¹ The summit

¹⁰See the writer's paper on Mount Field in *Proceedings of the Royal Society of Tasmania* 1921.

¹¹The Kosciusko Plateau (*Journal and Proceedings of the Royal Society of New South Wales* vol. LIX, 1925).

reaches 7,328 feet and is a small rounded dome about 900 feet above the adjacent plateau. A good motor road takes one to the highest point on the continent, which fact itself shows how strikingly the topography of Australia differs from that of the other great land masses. Cirque erosion is not so striking as on Cradle Mountain or on Mount Field in Tasmania. In summer great snow drifts, several hundred feet long and possibly 20 feet thick, lie on the sheltered eastern flanks of the divide, about 6,800 feet high. They usually melt in the autumn. In winter the snow-drifts are very thick over the plateau down to the 5,000 foot level. A little sapping leading to

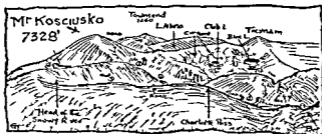


FIGURE 34—Relics of the Ice Age on Kosciusko moraines. The area sketched is about ten miles wide. Glacial cirques and moraines. View to north.

miniature cirques still seems to be occurring in sheltered hollows. Sir Edgeworth David has pointed out that the glacial evidence indicates at least two Ice Ages. The moraines near the summit are in many cases quite fresh in appearance (e.g., Jensen Moraine), and belong to the last ice advance. But at lower levels there are relics of much greater moraines (David Moraine) which go back to the earlier Ice Age. Cirques occur on a large scale near Blue Lake and Club Lake and a group of small cirques constitutes a sort of Larling on the flat range above Charlotte Pass.

At the maximum period an ice-cap covered most of the plateau above the 5,000 foot level. Ice flowed to the east from the highest land across the Snowy Gorge, over Guthrie Range, and so into the Crackenback Gorge. Over-deepening in the Snowy River Valley is not so marked as one would expect, nor are terminal moraines visible below 5,800 feet, but thick timber hides the portion below 5,000 feet. The most suggestive evidence at the 5,000 foot level is the occurrence of rounded granite blocks ("buns") which cover the level swamps and would appear to have been ice borne. The whole plateau, except

near the summit, is built of almost uniform granite which makes it hard to detect erratics

Finally the faunal evidence supports this change in climate. In the soft mud of the salt lakes the bones of the *Diprotodon*, a marsupial as large as a rhinoceros but akin to the wombat, have been found. These relics occur right across southern Australia, and Lake Callabonna (near Lake Frome) and Lake Darlot in West Australia are noteworthy localities. They lie in desert regions receiving only

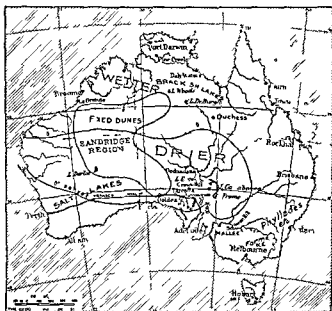


FIGURE 35—Sketch map to show how the climate has changed since Pleistocene times. The north is wetter and the south drier. (From *Geographical Review* New York 1919)

7 inches of rain a year. It seems unlikely that when this huge herbivorous animal was alive the herbage was as scanty as it is today in these regions (Fig. 35).

Turning now to the arid region immediately north of the desert belt and near latitude 20° the evidence is less well known, but it seems to indicate that conditions are now wetter than formerly. Thus the small lakes in this belt are usually fresh or brackish, as, for

example, Lake Woods, and Lake De Burgh in Northern Territory, and Gregory's Lake into which the Sturt River flows in Kimberley, West Australia. It seems possible that these inland *basins* are due to a cycle of arid erosion of which such hollows are characteristic. They have, however, become lakes through the wider range of the Tropical Rain Belt. With the warming which occurred after the Ice Age, we should expect the desert to be encroached upon, as has been explained earlier. The surface deposits also support this view. Great sheets of laterite and travertine, which are now forming in the south, are apparently breaking down in the north owing to the wetter conditions of today. (These hard surface layers are, however, explained by some scientists as being the former *subsurface* strata—from which the top soil has been blown away by wind.) The country around Duchess in northwest Queensland shows accordant evidence. Here luxuriant Mitchell grass covers a sheet of desert waste. The latter has apparently persisted from desert conditions, while the hills and plains, even in regions receiving 18 or 20 inches of rain, still show profiles recalling the "inselberg" ridges and "billiard table" floors so characteristic of *arid* erosion.

Thus there would appear to be quite clear proof that there have been marked climatic swings in Australia since man was in the vicinity. We may picture much more repellent conditions in the north during the Pleistocene Ice Ages than obtain today. These may well have prevented any higher race from following the aborigines into Australia. On the other hand, the changes in the south may help to explain the curious distribution of the tribes, whereby a rather primitive group of matrilineal aborigines occupies most of New South Wales (Fig. 39).

No doubt the "corridors" of migration were very different in Pleistocene times. From the north the best line of entry may well have been down the great rivers of the interior, between the deserts of the north west and the temperate jungles of central New South Wales. Nowadays the natural corridor would be along the western slopes of the cordillera, a route possibly 600 miles east of the old corridor. It is interesting that patrilineal tribes live in the old corridor—while matrilineal (usually more *primitive* tribes) are found in the better "corridor" of today. This is contrary to the usual distribution, and so may indicate considerable climatic change.

CHAPTER VII

THE DISTRIBUTION OF THE RACES IN THE AUSTRALASIAN REGION

A The Main Groups

This is probably the most complicated ethnological region in the world, since it has the most diversified environment and is quite near the centre of dispersion. Hence the later races have pressed out into the island areas while the older races have been preserved in many isolated mountain areas clothed with tropical jungle. We shall do well to tabulate the major races with their ethnological characters. The races are given in the order of superposition, i.e., the early primitive races below, and the younger, more advanced races above.

GENERALIZED SCHEME OF RACES IN THE AUSTRALASIAN REGION

No	Race	Types	C index	Hair	Stature	Skin	Nose
6	Paraeo-ean	Javanese	81 +	Straight to wavy	in 63	Brown	Meso-rhine
5	Later Polynesian	Samoaian Tahitian	79 +		68	Light-brown	
4a	N Melanesian	(Micronesian) Maasam	77	Wavy	65	Dark brown to black	
4	Mid Melanesians (Nesot)	(Igorota) N Solomons	75		63		Platy-rhine
3	Australian	Arunta Kamilaroi	73	•	65	Chocolate	
2a	S Melanesian	New Caledonia	72	Frizzy	65	Dark brown	
2	Papuan	W Melanesia W Papua	71		65		
1	Negrito	Acta Tapiro Tasmanian	Variable		58		"

*In December 1924 the writer investigated the tribes of aborigines living on the edge of the West Australian desert (for 500 miles from Nullagine to Yalgoo) and found that the women and children are largely tawny haired (see *Proceedings of the Pan-Pacific Science Congress Tokyo 1926* pp 2386-9)

In the above generalized table, I have made cephalic index the first criterion in establishing the ethnical types. It may be objected that such a classification splits up the eastern island peoples ("Polyne- sians"), such as Maoris and Samoans into different classes, and allies the former with the Massim of Melanesia. This seems to me logical, for the term "Polynesian" is based on habitat, language, and culture rather than on a physical basis. It would not be thought scientific to remove Booker Washington from the Negro races because his culture and language are exactly those of the educated West European.

As regards some of the lower races the classification is not so difficult. The groups of *Negritos* and *Australians* are distinctive, while the Papuan races have fairly definite characters. But the Melanesian peoples are especially hard to classify satisfactorily, as we shall see. Finally, the higher races on the frontiers of Asia are late comers into the Australasian region and can be correlated with certain Asiatic types with some certainty.

B The Negrito Peoples

These are scattered through a belt of "marginal" habitats from the Andaman Island to Tasmania. With the exception of these two extreme regions all their localities may be described as "inliers." In other words they have almost been overwhelmed by succeeding "strata" and are surrounded by the latter, who have driven them into forested highlands in every case. The Mincopi people of the Andamans and the Tasmanians who are regarded by Haddon as "a somewhat generalized variety of Negrito Papuan stock" were preserved up to recent times by their isolation in islands about 200 miles from the mainland.

In Fig. 36 the main corridor, used probably by all the early peoples, is shown by the heavy black line. In Pleistocene times this traversed level plains for much of its course. Since then Sunda Land and Sahul Land in the north have vanished, while in central Australia the corridor has in all probability greatly deteriorated in attraction, as I have shown in a preceding chapter. The present habitat of the *Negritos* is shown to lie off the corridor in general far to the east in the high ranges which once bordered the fairly continuous lands of the corridor. The broken line, including all the *Negritos* of today, defines a narrow belt which must not be taken to represent the line of migration of the *Negritos*. Each group of these branched off from much the same main corridor (as indicated by the short

arrows) No doubt the Tasmanians separated from the Negritos now living in Melanesia (the region from New Ireland to New Caledonia), somewhere near the Island of Timor or Celebes. So also the Aeta of the Philippines probably branched off from the main corridor near West Borneo.

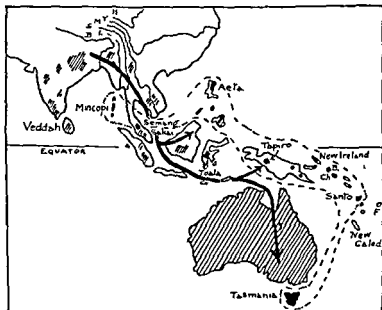


FIGURE 36—The Negrito (black) and Australoid zones (ruled) in the Australasian region (Partly after Biasutti) The main corridor leading to Australia is shown by the heavy black line The Negrito localities are enclosed in a broken line The six great parallel rivers of East Tibet are indicated (see p. 199)

C The Tasmanians

While it is probable that this people was not quite so primitive ethnically as the Negritos of Central Africa, yet the latter were in contact with much higher races, while the Tasmanians were completely isolated for centuries. The French explorer, Peron, first described them about 1800, and his notes are some of the most valuable extant, for the British took little interest in them later on when Tasmania was first settled (1803). In stature they were from 5 feet 2 inches to 5 feet 5 inches, but occasionally grew to 6 feet. In colour they were a dark brown, almost black.¹ The hair hung in corkscrew

¹A photograph of a typical Tasmanian woman is given on Plate I at 10

appendages about the men's faces, and there was much 'down' on the body. The hair grew low on the forehead and at the sides of the head on men and women. According to Dr Hickson, the hair at times was of a golden brown colour.

The eyes were rather small, the mouth very wide, but the lips were less full than the Negro's. The chin was small and retreating, and the face fairly prognathic, i. e., with projecting jaws. The nostrils were wide and full, and teeth large and powerful. The head index was variable but usually above 74, and a well marked "keel" characterized the top of the skull.

Every edible product of the region was eaten, from stranded whales to grubs and ants. Great shell middens still mark their resting places all round the coast. Various fungi, and the gums and pith of various trees were eaten, together with kangaroos, wombats, and opossums. They made no pottery, and so roughly roasted their food, if it were not devoured raw. Skins were used for rugs. For Tasmania has a climate like the south of England, and snowfalls are common in winter. Girdles, necklaces, and bracelets showed their love of ornament, while cicatrices and red ochre further added to their attractions. Singing and dancing filled much of their time.

Their technology was very primitive, for they had not begun to make polished stone weapons. Palaeolithic axes and scrapers were the highest expressions of their art. A wooden spear, with a point merely hardened in the fire, was their chief weapon, though they made clubs (waddies) to kill birds. They seem to have built rough beehive huts at times for such structures, large enough to hold thirty people, were seen on the west coast. But usually rough bark break winds like the gnyahs of the Australian aboriginal served all their needs.

Of special interest is the description which Peron gives of their rafts. They used three rolls of eucalyptus bark, which were lashed side by side. The central roll was 14 feet long and 3 feet wide, and the lateral rolls were 12 feet long and narrower. This raft was made more solid with reeds and would hold up to six men. Other observers saw a raft 6 feet wide and 30 feet long which would hold six people and this would float in rough water. For instance, it is recorded that they crossed three miles to the Maatsuykers Island on the stormy west coast. There seems to be no reason therefore why, when migrating, they should not have crossed the straits both in the East Indies and north of Tasmania in some such craft.

We have no knowledge of their numbers when the British settlers

first arrived in 1803. According to Milligan,² two thousand included them all. From his data the adjoining "extinction curve" has been plotted at the right of the graph (Fig 37). They were ruthlessly slaughtered in the early days, and only 111 were alive in 1834, and 44 in 1847. Drink and disease quickly killed these. In 1854 there were 16, and the last male, William Lanney, died of drink in 1865 leaving four women. The last Tasmanian woman, Truganini, died at about fifty years of age in 1876.

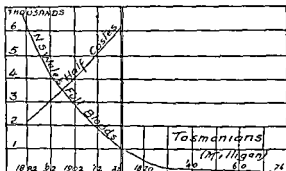


FIGURE 37—Graphs illustrating the extinction or merging of primitive races. On the right the data collected by Milligan about the Tasmanians are shown; on the left the change in constitution of the coloured folk in New South Wales.

The attempt to conquer the Tasmanians in the famous "Black Drive" of 1830 was a complete fiasco, for every native save one eluded the cordon! At present there are a number of half castes and quarter castes on Cape Barren Island in Bass Straits, and an aged quarter caste niece of Truganini till recently lived on an aboriginal reserve near Moama on the Murray.

D Melanestian and other Negritos

In Melanesia Negritos of somewhat similar types occur in very small groups in the interiors of the largest islands. In many cases the pure bloods have become practically extinct, as in Santo Isle, and the chief evidence of a former Negrito settlement is the presence of tribes of smaller stature than usual, often with rather higher head indices than those of the surrounding tribes. Indeed, as the Negritos

²James Walker 'Aboriginals of Tasmania' (Proc Roy Soc Tas 1898) Tindale has recently described Tasmanoids in N E Queensland.

of this portion of the world become less pigmy like so their head index decreases as the following table shows

<i>Group</i>	<i>Tribe</i>	<i>Cephalic index</i>	<i>Stature</i>	<i>Hair</i>	<i>Skin</i>
Asiatic Negritoes	Aeta (Thalipanes)	70.6	4 0	Peppercorn	Chocolate
	Mincopi	82.1	4 11		Black
	Semang	70	6 0		Chocolate brown
	Tapiro	70.5	4 0	Friszy	Yellow brown
Mixed types?	Sakai	79	4 11	Wavy	Black
	Tasmanian	74.77	5 5	Friszy	Dark brown
	Veddah	73.75	5 1	Wavy	Chocolate
(For comparison)	Australian	77	5 5		

The most probable explanation is that we are dealing here with two original stocks best illustrated by the Australian and Aeta. The Tasmanian is probably a half caste between the two. He has the stature of the Australian, the hair of the Aeta, and an intermediate cephalic index.

The Tapiro Negritoes have been investigated by Wollaston.¹ They live just to the south west of Mount Carstensz in Dutch North Guinea at a height of over 7000 feet. They are active little fellows with big buttocks and big calves, thus being quite unlike the Papuans in the swampy coastslands below them. The nose is straight but very wide, the upper lip long and curiously convex. The hair short, woolly and black, and the men have short bushy black beards. Their weapons are bows and arrows, flint knives and duggers made from cassowary bones. Instead of mere wind breaks, their houses are built on piles and made out of lath and bark. They are therefore much ahead of the Tasmanians in culture.

F. The Australian Aboriginals

Owing to its age long isolation the continent of Australia has a remarkably uniform series of original tribes. All authorities agree that they entered from the north and drove the Tasmanians before them. There is however considerable difference of opinion as to whether the Australians came into the continent in one great migration and thereafter differentiated into varieties, or whether their characteristics were determined before entering, so that they arrived in Australia with the attributes of several different migrations. We

¹A. I. R. Wollaston, *Pygmies and Japans* (London 1912).

²See photographs on Plates I and II nos. 8 and 18.

shall do well to consider their salient features before attempting to decide this problem

Spencer⁴ points out that there is a broad division into eastern tribes with female descent (matrilinal), and western with male descent (patrilinal). Further, although there is an extraordinary homogeneity in their method of organization, yet there is a strong divergence in such matters as burial, weapons, etc. As in many primitive peoples, the individual is primarily a member of a special tribal-class, and only to a minor degree does he associate with his close blood relations. In other words, the idea of family relationship, universal among higher races seems to have developed after the Australians left Asia

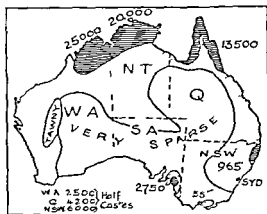


FIGURE 38—The present distribution of full-blood aborigines in Australia. Tribes with tawny hair met with in 1924, occur in Western Australia.

The boundaries of the tribe were very definitely limited, and usually trespass gave rise to tribal warfare. But for certain special "crops," such as the fruits of the *Araucaria* in Queensland or the "bogong grubs" near Kosciusko, these trespass laws were temporarily suspended.

Today there are about 60,000 full-bloods in existence. Of these, 36,500 are described as nomadic, 9,000 are in regular employment, and 10,000 are living in supervised camps. They are to be found mainly in the northern coastlands, especially in Western Australia, furthest away from the region of densest white population. The distribution is given in Fig. 38, which also shows the area where the writer en-

⁴B. Spencer, *Federal Handbook to British Association* (Australia, 1914)

countered tawny haired aboriginals. A description of aboriginal life in contact with white civilization will be found in our paper "Kamilaroi and White"⁶. The gradual replacement of full bloods by half castes in New South Wales is shown by the graph in Fig. 37.

Their food ranged through as extensive a programme as did the Tasmanians'. Kitchen middens from 20 to 50 feet high are known near Port Phillip and Botany Bay, and smaller middens are common elsewhere. Yams and vine roots were eaten. The sporocarps of Nardoo (*Marsilea*) were ground into paste on stone mills, which are still very common along the Darling River. They are expert fishermen, and the stone weirs at Brewarrina (N S W) were perhaps their most elaborate "monument". In these crescentic pools, built every year across the rapid Barwon River, Murray Cod up to 120 pounds' weight were secured. They also made large nets in which emus were caught.

Much of their time was spent in "magic," which was essentially their religious life. The motive of most of the tribal laws and customs was probably to strengthen the power of the older men. Hence strict ceremonies accompanied the initiation of the younger men, while the women have a very low place in the aboriginal scheme. The following description is given by Howitt of an initiation ceremony for the tribes of the south east quarter of New South Wales.

The head man sends a messenger to the other tribes who may be associated together for these ceremonies. He carries a "churinga" (or bull roarer) as a credential, and also various message sticks (The latter are strips of wood 8 inches long, with notches on the edges which serve to memorize dates and people. They are in effect a primitive form of writing.) The ground for the corroboree is now prepared, and usually a more or less sacred site is used. A circular ridge about 50 yards in diameter is built up for the public ceremonies, while a smaller circle is made ready some 400 yards away in the bush. As the visitors arrive they dance and their leaders do "magic". The women are congregated around the larger circle but turn their backs at the more important stages of the ceremonies.

The boys are painted and brought along by their sponsors, who are usually brothers of the potential wives. These men teach the boys the laws and legends, and give them their adult badges. Finally,

⁶G. Taylor and F. Jardine in the *Journal and Proceedings of the Royal Society of New South Wales* Sydney 1924.

in the smaller enclosure, to the sound of the bull roarers, which are swung with a whirring sound, a tooth is knocked out with a mallet, and the boy becomes a man. This ceremony marks the time when he leaves his mother, and throughout is accompanied by much buffoonery and gesture.⁷

The Australians are much higher than the Tasmanians in their technology. They make beautiful flaked spear heads and knives and many of the stone axes are as finely polished as those of the Neolithic

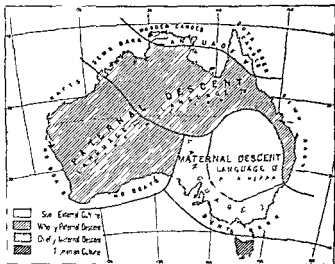


FIGURE 39—The chief culture zones in Australia. Social grouping (descent), language, navigation, etc. are the bases of classification. (After Sollas, Curr, and Graebner.)

Age in Europe. Spears and clubs are their chief weapons, and great differences occur in the varieties of wooden shields. In Victoria the latter consists merely of a bar of wood, only 2 inches wide, while in North Queensland huge elaborately painted shields are customary. The boomerang and womerah (spear thrower) are characteristic weapons, but both are used among primitive folk of the same status nearer Asia. The womerah is not found in the south-east of the continent (i.e. where descent largely passes through the mother).

A number of investigators draw attention to the fact that there is a

⁷For the sociology and anthropometry of the hybrids between Kamilaroi and White, see paper by Taylor and Jardine, *op. cit.*

gradual evolution in culture from south to north (Fig 30) Assuming that the Australians arrived in one uniform migration it is difficult to see why these culture zones should be arranged in this fashion Thus we find that the southern tribes have either no boats or use only pieces of bark bent into rough canoes Those on the west coast (near North West Cape) build rafts Then in the zone nearer Asia both on the east and west coasts we find tribes who sew the bark to make a more elaborate canoe Finally on the north coast we find wooden canoes and in North Queensland outrigger canoes

As mentioned previously the south eastern tribes mostly count descent through the mother The children may look to the mother's brother for paternal care and the true father is often of much less importance to them This stage usually implies a more primitive development than descent through the father, which obtains among the remaining tribes in the centre north and west The latter tribes also practise circumcision

Schmidt * who has studied the structure of the various languages is satisfied that there is a gradual evolution, in general from south to north Thus the south east languages have the genitive noun *following* the object possessed as in Tasmanian languages These were spoken by the first migrants The next migration used a genitive *preceding* the noun The last migrations did not use initial R or initial L in their vocabularies (Fig 30)

F *The Date of the Migrations into Australia and Tasmania*

A valuable paper by Sir Edgeworth David on the geological antiquity of the aborigines was published in 1921 † upon which the following notes are partly based The evidence may be discussed from several points of view The geological biological and cultural aspects are all worthy of consideration Perhaps one of the chief features is the presence of the dingo in Australia and its absence in Tasmania The dingo was introduced into the mainland before some of the extinct marsupials died out and almost certainly entered with the Australian aboriginal The nearest of the dog tribes to the dingo seems to inhabit Syria rather than Eastern Asia so that this animal may have accompanied the aboriginal from Central Asia The dingo seems to have been responsible for the extinction of the marsupial

*In *Anthropos* 1912

† R M Johnston Memorial Lecture (*Proceedings of the Royal Society of Tasmania* 1921)

"tiger" and devil on the mainland. They have survived in Tasmania owing to his absence.

The Tasmanians had a 'balsa' or raft, as we have seen. They could readily have crossed from island to island, even today the largest gap in Bass Straits (from Victoria to Deal Island) is less than fifty miles. This gap may have been much less when the Tasmanians crossed, since we know (from Hedley's work) that the marine molluscan fauna has not yet traversed Bass Straits, but that the east and west types are readily separated. Any primitive tribe would take to its rafts as a last resort from the sustained attacks of a stronger race, and some few of these craft might have reached Flinders Island.

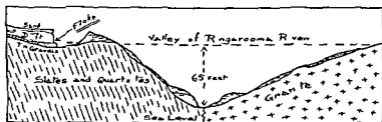


FIGURE 40—Vertical section of Peaty Drift 65 feet above the present Rngarooma Valley Tasmania in which a Tasmanian artefact was discovered (After Sir Edgeworth David)

whence land extends nearly continuously to Tasmania. However, it is difficult to fix a date for the migrations. If the Tasmanians have been in these latitudes (akin to Falmouth, England) for many thousands of years, it is difficult to understand why they did not become somewhat bleached from their dark brown colour.

On the other hand there is strong evidence indicating a far distant date for the first habitation of Tasmania. Sir Edgeworth David describes a retouched chalcidonic flake which was found 10 feet below the surface in the gritty, peaty drift over the tin gravels of the Doone Mine in north-east Tasmania (Fig 40). The undulating floor on which the gravel rests is 65 feet above the present river. Evidently a great amount of erosion has taken place since the peaty drift was deposited, and Professor David thinks it dates back at least to the Wurm glaciation and perhaps even to the Riss period.

There can be no doubt that the Tasmanian entered Australia before the Australian aboriginal and before the dingo, perhaps 50 000 years ago. The Talgai skull, with its huge faceted canine teeth,

seems to show a very great age for the aboriginal in Australia¹⁰ This famous skull was discovered near Warwick (South Queensland) in red clay at a depth of about 7 feet In the vicinity similar sediments contained bones of extinct marsupials, such as the huge *Diprotodon*, of Pleistocene age The skull is unusually prognathous, almost ape like, but the brain case is human The facets on the huge canine teeth are very characteristic

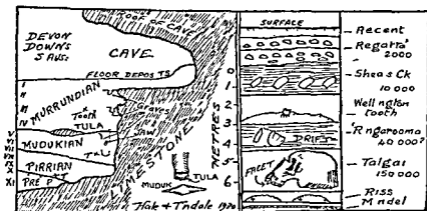


FIGURE 41—At left Vertical section through deposits in a shallow cave on the Murray River near Murray Bridge (South Australia) Two artefacts are sketched in the corner At right Generalized section illustrating the antiquity of man in Australia and Tasmania

Very interesting archaeological work has been carried out in caves on the Murray River near Murray Bridge (South Australia) Here Hale and Tindale have excavated 6 metres of debris as shown in section in Fig 41 The variation in the species of shells (used for food) shows that the climate was wetter than now when the lower "Pirrian" layers were deposited Curious bones called *Muduk* mark the middle layers They were perhaps used in fishing In the upper layers flint adze-edges called *Tula* were common Human remains were discovered, usually of more primitive type than the average aboriginal of today It has not yet been possible to date these layers

Some of the data discovered in Australia are arranged in the table at the right of Fig 41 Artefacts found at the Regatta Ground in Tasmania seem to date back about 2000 years Near Sydney a number of stone axes were found at Shea's Creek, which had been

¹⁰See S. A. Smith in *Philosophical Transactions of the Royal Society of London* 1916

covered by 11 feet of silt. Perhaps they are 10 000 years old. In the travertine of the Wellington Caves (N.S.W.) a human tooth was discovered. Perhaps still older is the Ringarooma flake roughly sketched in the section. The Talgai skull is possibly 150 000 years old.

G Status of the Australians

One of the difficult problems of ethnology is to discover the relative positions of the Australians and Negroes in the ethnological scale. It seems to me that the geographic evidence is helpful here. We may assume that the lower Melanesian (who is described in the next section) is comparable with the lower African Negro. Thus Keane gives the following data:

	Cephalic index	Cranial capacity	Facial index	Hair	Skin-colour
Central Africans	71.2	ccm 1 424	70	Woolly	Chocolate to sooty
Papuan	70.4	1 412	69		

They have been so long separated that we can expect little resemblance in their culture, but the keloid scars, drum language and totems are common to both families.

If we now follow the migrations back (see Fig. 36) to Asia we find that the bulk of the *Dravidian folk* of India, who are certainly nearer the Indo-European than are the Negroes, form the stratum which next overlies the Veddah-Australian type. Indeed many features of the Australian types are preserved in India, such as the Nairs of the Malabar region, the Todas, Badagas of the Nilgiri Hills and the Mundas of the north. We do not find any Negroid people in Asia or Indonesia, except the Sakai and Semang of Perak, until we reach the Papuan region in the island of Flores. It seems clear therefore that the Papuan Negroes were largely confined to the Indonesian Islands long before the Australoids left the mainland, and indeed it is possible that many Negritoes were present in Asia long after the Papuans had left. Putting it the other way, if the Papuan were a later migration than the Australian, we should expect to find features of Papuans in South India and the Australians entirely pushed to the wall, whereas the contrary is the case.

We may assume, then, that the distribution supports the view that the Australian with his wavy hair is ethnically higher than the Papuan with his woolly hair. Blood tests by Dr Tebbut and others show a remarkable similarity between the blood of the Australian aborigines and that of West Europeans. This indicates, perhaps, an Australoid stratum in Palaeolithic Europe. No doubt the isolation of the Australian kept him at a very low state of civilization, moreover, his habitat produced few fruits and grains which might lead to the development of agriculture, and no animals which corresponded to the herds of the primitive pastoral peoples. Hence he remained a primitive hunter living from hand to mouth.

It is hard to see why the Papuan never entered Australia, since the Negrito reached both Australia (as the Tasmanian) and Papua (as the Tapiro, etc.), but some ethnologists (not including the writer) consider the Tasmanian to be a variety of the Papuan. Probably the complicated topography of the East Indian region and the drowning of the flat lands of Sunda and Sahul determined the paths of the various migrations, and we must leave the elucidation of this problem to a later date. Something like the following may well have taken place.

Perhaps we may assume a Negrito migration during an early glacial period, when it was easy to get into Papua and also into Melanesia and Australia. Then the Papuan hordes moved to the south after Australia was shut off by the drowning of the Sunda region. They entered Papua at a time when we may imagine extensive deserts in northern Australia for reasons given earlier. They drove the Tapiro into the hill jungles. Later the first horde of Australians arrived during an Ice Age, when the Sunda and Sahul areas were dry land. They moved down the central rivers to the south east. They mixed with the Negritoes in the south to some extent, producing the Tasmanian type. The next migration drove the Tasmanian further south, and was in turn driven into the thick forested regions of New South Wales by the latest migrations (Fig 28).

The continent was now closed to further migration from Asia, and the tribes reached a state of equilibrium. But the environment gradually changed for the worse in southern Australia. The attractive central portion, the ancient corridor, became almost desert, the thick forest of inland New South Wales became open, grassy plains. But it is possible that the tribes were "anchored" to their tribal grounds, and so we find the anomaly of later and probably higher patrilineal migrations occupying poor ground, while the earlier matrilineal tribes

have (or had) some of what is now the best country in Australia. Still we find the later migrations were beginning to invade the east coasts, as is apparent in the map (Fig 36)

H Papuan and Primitive Melanesian

Quite distinct from the Australian aboriginal in many ways is a group of people whose present range is from Flores (400 miles east of Java) and the Moluccan Islands on the west to Fiji and New Cale-

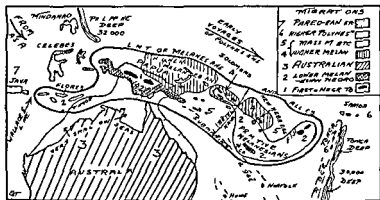


FIGURE 42—Festoon Islands of Melanesia with their races—some what generalized

donia on the east. They thus occupy the islands on the eastern rim of the Banda Deep (see Fig 28). In Melanesia they are found chiefly in the southern and western isles. In all cases the skin is very dark, in some parts even sooty in colour. The hair is extremely frizzy, the nose is often hooked and Jewish in appearance, the face long, and the skull markedly dolichocephalic (C I 73). There is often a well-marked brow ridge (frontal torus)¹¹

There is a rather well marked distinction between the peoples of New Guinea in the west of this ethnological division and those inhabiting Melanesia to the east. The latter speak languages which belong to the common *Melanesian* stock, the former have quite different and very varied languages which are described for convenience as *Papuan*. (We shall see a very similar classification in Africa, distinguishing the Bantu Negroes from those Negro tribes, otherwise

¹¹Photographs of Melanesian people appear on Plates I and II nos 12 and 23

somewhat similar, who speak alien tongues) Judging by analogy we may look upon all these long headed Negroes, who migrated from Asia about the same time, as of similar origin But possibly those living in the small islands came under the influence of a great migration of later comers (the higher Melanesians) who spoke a new tongue which the primitive island folk adopted

The salient feature of the organization of the primitive Lower Melanesians (2, in Fig 42) is their division of each tribe into two exogamous groups Each of these has a totem (which we may briefly describe as the tribal symbol), often one totem being light coloured and the other dark This may refer to a racial mixture of aboriginal dark peoples with less dark invaders Marriage takes place only between members of different groups hence the name of "Dual group Melanesians" is given to this stock Descent was chiefly through the mother Body scars (keloids) are thought to improve the appearance just as in Australia Magic plays a very large part in their lives and they inter their dead in a crouched position Secret societies of a complex nature terrorize the community, in which a ritual of masks and bull roarers shows a culture stage little different from the Australian

The Higher Melanesians Living almost side by side with the primitive Dual group peoples is a much higher race (4, in Fig 42) which has unfortunately also been classified under the term Melanesian They have few characters in common, though certain transition types are to be expected The cephalic index is 76 as opposed to 73 There is no exogamy, and the physical features are much more refined These higher races are smaller and lighter coloured The skin ranges from bronze to *cafe au lait* The hair is usually rather frizzy, but may be ringletted or wavy The usual beverage is "kava," prepared by macerating a root like ginger, and much ceremony accompanies kava drinking In many respects they resemble the primitive peoples of Europe of Mediterranean race Thus they tattoo in almost all the tribes They indulge in skull hunting, they built stone monuments, and the curious custom of the *couvade* is characteristic of them ¹² All these customs characterized the earlier Western Europeans (such as the Irish, Basques, Corsicans etc), and may be traced in the earliest descriptions of them when in a state of barbarism

These higher Melanesians are found in the northern and eastern

¹²*Couvade* on the birth of a child the father takes to his bed for a space of days or weeks and abstains from certain foods and practices (Fig 43)

islands chiefly. They are akin to the Nesiots of the East Indian Islands. Dolmens and stone circles mark their migrations and occur in New Britain in Eastern New Guinea in the Banks Islands in the Solomons and in Santo and Pentecost in the New Hebrides.

Many anthropologists have noted that the customs mentioned above are found in a zone extending from the British Isles to New



FIGURE 43—The habitat of the Mediterranean race shown by dots. Arrows marked E show hypothetical diffusion of race and cultures from Egypt—giving a *perspherical* migration. A radial diffusion of race (and much culture) from the cradle-land (C) is more logical. Insets show Couvades sites from L. g. Roth.

Guinea and further. Perry and his school believe that this indicates a *perspherical* migration of culture from Egypt to west and east. The writer believes this common culture far antedates Egypt and goes back to the cradle land in Southern Asia. The cultural features have spread *radially* from Asia all over the world (Fig 43). Egypt is therefore only *one* of many places which have experienced the same wave front of culture spreading wherever the brown Mediterranean race has migrated.

Migrations of the Melaneseans We can trace the Melanesian migrations only from anthropometric or cultural evidence. Their legends are of no such value as for instance those of the Polynesians. Almost everywhere where the Polynesians settled we find traces of the lower races. It seems likely that they or their allies extended from

Madagascar to Easter Island As regards the former locality, T A Joyce has shown that a small section, the Antimerina, who were the dominant people in the nineteenth century, "is of fairly pure Malay (or Javanese) blood, and is composed of sixteenth century immigrants, but the language belongs to a very early branch of the Malayo-Polynesian family' It is possible that the earliest and Negroid inhabitants of Madagascar were Melanesian Negroes¹³ As regards Easter Island although it lies 5,000 miles to the east, the evidence advanced in Mrs Routledge's book¹⁴ shows that the slit eared statues differ little except in size from similar figures in Melanesia Their bird cult recalls that associated with the frigate bird in the Solomons The dolmens and cruder structures are found in Melanesia in islands where no Polynesians ever landed, as well as in those at present considered as Polynesian The pyramids and *marae* (walled yards) may, however, have been built by an early Polynesian migration

The Polynesians These interesting peoples comprise several ethnic stocks who are allied in much the same fashion as are the Alpine and Nordic people of Europe In other words, they have a common language, culture, and environment, but are not in a physical sense people of the same race There is the greatest difference between the dark, medium sized, leptorhine, long headed Maori and the fairer, tall, somewhat platyrhine and very brachycephalic Samoan The former approaches physically the West European, the latter is nearer the so-called Mongolian This resemblance is no accident but illustrates an important general principle In effect, while one group of peoples was migrating to the western periphery of Asia (i e, Britain), an allied group was migrating to the south east and later reached about the same position with regard to Central Asia, e g, outer Polynesia (Fig 44) Thus we find the peripheral folk of Hawaii (in the north east) and New Zealand (in the south east) linked together in certain physical and cultural aspects, although in the former case there is evidence of mixture with a mesocephalic type, and in the latter with an element with a strong Melanesian strain Both peoples have heavy beards, which are absent in most Polynesians Indeed, it is almost impossible to distinguish some Hawaiians and Maoris from certain dark Europeans

The typical Polynesians are as a whole some of the tallest people in the world, 5 feet, 10 inches is quite a usual height The later

¹³*Guide to the Ethnographic Collections in the British Museum* p 245

¹⁴*Mystery of the Pacific* (London 1919)

Polynesians have often a very light brown skin the earlier Hawaiians and Maoris are a much darker brown The hair is wavy to straight and of the same type as European hair, but always black in colour There is a tendency to obesity The face has regular features, so much so that many of the women are quite beautiful¹⁶ The eyes are black Tattooing is common and reached its greatest development in New Zealand We note that the Igorots of the Philippines and many of the highest Melanesian folk of New Guinea (whom the writer places in the same zone) were their rivals in this respect Tattooing, indeed is a marked character of the migration zone with a cephalic index near 76

The Polynesians had a high social organization with powerful chiefs and women played a relatively important part in affairs They had a strong religious sense free from the gross beliefs of the Melanesians The earlier migrations seem to have built large stone temple enclosures (*marae*), and in certain islands they erected truncated pyramids These stone monuments belong to a more elaborate cult than the dolmens and circles of the higher Melanesians and are found in Micronesia (Ponape) Tahiti Tonga and elsewhere

They had no knowledge of metals, and in most cases no pots We must remember however, that in many islands there was no clay, though this does not apply to the largest Polynesian islands Carving is very elaborate and elaborate plaiting and mat making are characteristic Their canoes were especially noteworthy and enabled them to sail over the whole Pacific It seems possible that about A D 900 a Maori explorer discovered the frozen seas of the Antarctic nearly a thousand years before Captain Cook reached the same latitude New Zealand was first discovered about A D 650 by Polynesians who probably set out from Tahiti Their legends refer to a land of Hawaiki but this name is found throughout Polynesia under the form Savau (Samoa), Avaiki (Raratonga) Havai (Tahiti), Hawaii and Havaiki (Marquesas) It has even been suggested that Java and Saba (Sheba) are similar modifications

Migrations of the Polynesians There is little doubt that the Polynesian peoples represent a disrupted zone of races who originally inhabited the south-east of Asia (Fig 44) Judging by the general laws of migration we should expect to find their congeners still living in the highlands of India and Burmah on the one hand and in Manchuria or thereabouts on the other hand Many allies might be

¹⁶Photographs appear on Plate I at 2 and Plate II at 15

expected in America, and this is precisely what we find when we examine the physical and cultural evidence. In the annexed sketch-map (Fig 44) these migrations are indicated. We may picture a time reaching back to the Azilian period perhaps, when the Polynesians and other tribes of the same stage of evolution occupied the habitat shown as Proto Polynesian. Later on, for thousands of years the Polynesians were slowly pushed to the sea by the Chinese and allied folk (shown by dots). For many centuries the Polynesians occupied Eastern China and Further India, and no doubt became expert navigators. Intense desiccation in Central Asia drove out most



FIGURE 44—The expulsion of the earlier zones of races from Eastern Asia by the later Alpines (shown dotted in Asia). It explains the similarity of the Amerinds and Polynesians. (Partly after Dixon)

of the so called "Mongolians" and they spread down into the coast lands, probably about 5,000 years ago. The Polynesians abandoned the mainland and migrated eastward. A few went south and settled in the Mentawai Isles of Sumatra, for here the Nias tribes speak a Polynesian tongue. But most of them kept north of Indonesia and swept to the east without occupying the islands already fairly fully occupied by earlier races such as Negroes and Australoids.

It seems logical to the writer to replace the general term "Polynesian" by three racial names already familiar to the reader, *Alpine*, *Mediterranean*, and *Negro*. Although a common culture unites these interesting navigators, there is no more racial unity than among the peoples of Europe. Dixon in his book *Racial History* (1923) has shown that there is a widespread *Negro* population which is found

mainly in the area shown by diagonal lines in Fig 44 This migration moving out first occupied the nearer Melanesian Isles—but also reached as far east as Easter Island

A second migration consisted mainly, we may imagine, of *Nesiot* types (akin to Mediterranean) whom Dixon calls Caspian types (Fig 44) They do not seem to have sailed as far east, but are numerous in the North Island of New Zealand and elsewhere A third group of peoples the *Alpine* types (Fig 44), ventured far afield settling Hawaii and the South Island of New Zealand as well as forming the overlords in many of the other islands No doubt some of the migrations were of mixed race to start with, but the term Polynesian is clearly rather a misnomer as applied to a *race*

It seems probable that the Polynesians lost touch with Asia about 3 000 years ago They have no trace of Sanscrit words which were influencing the languages of Indonesia about 350 B C But their culture, especially the ceremonial dances, recalls that of the Indonesian peoples So also the languages of Java, Formosa certain Philippine tongues and Japanese have affinities This aspect will be discussed in the Asiatic chapters

It must be understood that there was internal warfare among the Polynesians The later-comers pressed forward and dispossessed the earlier Thus we find that the Northern Maori (an early type) was pushed further and further away by later types No doubt this was one reason why he left Tahiti His legends refer back to a date about A D 650 as the period when U i te rangiora first landed on New Zealand The discovery of Melanesian carvings in the bogs north of Auckland may, however show that in New Zealand (as in many other Polynesian Isles) a substratum of Melanesians was absorbed by the new-comers a suggestion confirmed by physical anthropology Certainly the Maoris and their allies, the Moriori (who occupied the Chatham Isles), contain many strains of Oceanic peoples, and the unravelling of their descent is occupying New Zealand ethnologists

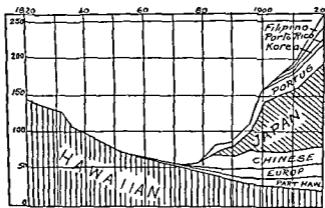
In various papers H D Skinner¹⁴ discusses the stocks from which the Maori tribes are derived The earlier tribes settled in North Island, and their culture has strong affinities with the arts of the Massim people of Papua, the Sepik River, and the Solomons Thus the spiral ornament the single canoe, the type of tattooing, and the adzes are all akin to these highest of the so-called Melanesians

The Southern Maoris came later and are akin to the Moriori of

¹⁴ Polynesian Origins (*Journal of the Polynesian Society*, 1923)

the Chatham Isles. They are more truly Polynesian, with double canoes, with outriggers, no pile houses, simpler carving, and Polynesian adzes.

As regards these outer "Polynesian" Islands, Dixon points out that Hawaii was first settled by folk akin to those of Indo-China and then by pure Alpine peoples of a later evolved type. Easter Island has a first "layer" of Protonegroid, akin to the similar Melanesians, followed by his "Caspian" type (akin to many Japanese). New Zealand has this latter stratum in the north with many later "Alpines" in the south similar to those filling the central Polynesian Islands today.¹⁷



Race Mixture in Hawaii

In a recent survey in Honolulu the author was greatly struck by the appearance of the Oriental population. At the University of Hawaii they are said to be on the whole keener and more industrious than the European students. They appreciate the opportunity (almost unique in the world) to live the American way of life, and they acted loyally in the Home Guard during the recent war. The accompanying chart shows the changes in the cultural composition in the years from 1820 to 1920. (See also p. 475.)

Fundamentals of the Present Population

This book is primarily concerned with the migrations and distributions of folk in the Pre-Columbian period. But since the environmental factors continue to operate today, it is worth while giving a little attention to their effect on the present population. In the latter part of the book four chapters are devoted to the problem of environmental control in Australia today, and the reader is referred to Chapter XXVI accordingly.

¹⁷Roland Dixon, *The Racial History of Man* (New York, 1923)

CHAPTER VIII

THE CHANGING AFRICAN ENVIRONMENT

A *The Build of Africa*

"Africa as a whole is a world segment entirely distinct from all other continents. It is a great solid mass raised perpendicularly from the sea and, with the exception of the Atlas Mountains, has no true mountains or fold mountains of recent date, like the other continents. From north to south one dominant *motif* runs throughout, and can be recognized in the equatorial forests of Guinea or the Congo, or in the deserts of the Sahara or the Kalahari. Perhaps the *black man and the thorn tree* summarizes this African *motif*, though countless varieties of both exist"¹

If we refer to the block diagram of Africa (Fig 45) we see that the continent is logically divisible into two portions of almost equal area by a line joining the Congo mouth to the Red Sea near Suakin. Almost all the southern portion is a plateau over 3,000 feet, while most of the northern portion is under 1,500 feet. Of land below 600 feet, there is a considerable amount extending across the Sahara from Cape Verde to the Nile mouth, the other important lowlands extend along the east coast chiefly to north and south of the mouths of the Juba and between the Zambesi and Limpopo.

Of true fold mountains there are only the ranges of the Atlas in the north west, which are of the same age as the Alps of Europe. In the extreme south west near Cape Town are some ancient fold mountains. Thus Africa is the sole continent which departs from the normal build, which consists of Shield, Downfold, and Young Mountains (see p 14). But Africa has been greatly affected by *faults*, and probably also by broad warping (*epeirogenic*) movements. Volcanoes are abundant in association with these structural changes, and have built up the highest mountains such as Kilimanjaro, 19,320 feet, Kenia, 17,000 feet, Mfumbiro, 14,600 feet, Ruwenzori, 16,000 feet, and the Cameroons, 13,400 feet. The vast extent of the Shield is indicated in Fig 3.

The highest land extends from Abyssinia down the east coast, and is associated with a unique series of lakes of which the chief are Tana, Rudolf, Victoria, Tanganyika, and Nyasa. These are perched on the relatively narrow plateau and clearly indicate by their precarious

¹E. H. L. Schwarz *A South African Geography* (London, 1921), which I have freely consulted.

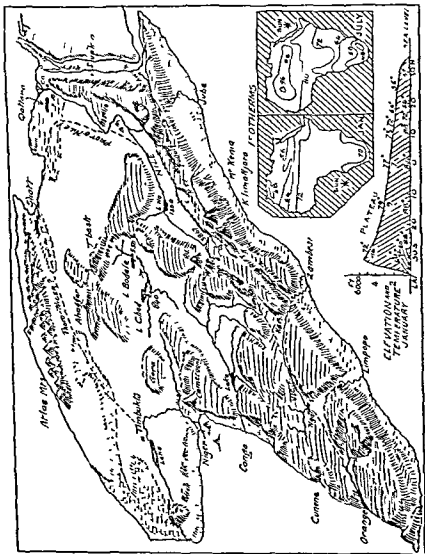


FIGURE 45.—A block-diagram of Africa. The lower inset shows a generalized vertical section from south to north through Africa. It illustrates how elevation cools the south in January.

position the recency of their formation. Each is drained by a large river with a steep grade, and in a comparatively short time these lakes will be emptied unless further crustal movements supervene. Indeed Lake Tanganyika has been tapped by the Lukuga (a tributary of the Congo) since it was first discovered, and its surface has been considerably lowered.

To the north west of the great plateau extends the great series of lowlands of North Africa, bounded by the Congo and Nile Rivers. There are only two highland areas of note. One constitutes the Cameroons massif, and the other is an elongated series including Darfur, Tibesti, and the Ahaggar highlands. The Kong Mountains shown on old maps behind the Gulf of Guinea, have shrunk in size as surveys progress and are really non-existent. Only the Futa Jallon highlands at the head of the Niger are worthy of note.

The drainage system of Africa is of great interest, and shows that remarkable changes have occurred within the last geological epoch. Except for the Nile which itself has a very varied history, the main rivers all flow in arcs mostly along an east-west axis. Thus the Niger rises just behind Sierra Leone, flows towards the dry interior, and spreads out into huge swamps and lakes near Timbuktu, thus indicating a local base level. Thereafter it sweeps round to the south-east and ultimately enters the sea through the somewhat higher region flanking the Gulf of Guinea. Schwarz is of the opinion that the Proto Niger flowed from Timbuktu to the north *via* Lake Gurara and entered the Shotts of Algeria, and so reached the Gulf of Cades. The Congo has a similar curved track: for it rises near Rhodesia, flows north beyond the Equator, and then south to the great lakes and swamps of Stanley Pool (another local base level) before plunging rapidly through the coast scarp to its outlet.

The Orange River has a more direct course from east to west, but it seems probable that in the not far-distant past its northern affluent (Nasob) once brought water from near Lake Nyasa and Lake Benguela *via* the Okavango and Lake Ngami. Here again we have a vast series of lakes and swamps some 400 miles wide (including the Makari Kari region) which are now dry and silted up. Before 1820 these rivers were flowing and the swamps contained hippopotami and other animals which have long since died out.

The Zambezi River appears to have captured much of the internal drainage only recently in geological history. It leaves the plateau by the Kebrabasa Falls while the Victoria Falls are at 3 000 feet elevation.

and some thousand miles from its mouth. The history of the Shiré River, which links Lake Nyasa to the Zambesi, is particularly interesting as regards the changes in African geography. In 1889 it was possible to bring steamers from the sea to Lake Nyasa *via* the Zambesi and Shiré, a distance of some 400 miles. Soon the lake sank through desiccation, and steamers could only reach Chiroma (180 miles from the lake). Then water failed above Port Herald, and now in dry seasons steamers can hardly reach the junction of the Zambesi with the Shiré, 100 miles from the sea.

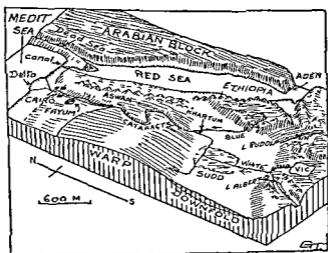


FIGURE 46—Block-diagram of the Nile Basin and the Red Sea Rift. Note the warps which have led to the Cataracts and the Sudd

The Nile is the sole African river which has a north-south course. It rises in various streams which enter Lake Victoria (3,867 feet) or Lake Edward. The two branches unite at Lake Albert (2,229 feet) and flow north as the Mountain Nile (Jebel) to the great flat expanse near the Bahr el Ghazal (1,350 feet). Here are extensive swamps, and floods may cover hundreds of square miles. This region is, therefore, a base-level analogous to the Lake Chad and Lake Ngami regions. Were it not for the Blue Nile (rising in Lake Tana in Abyssinia) no water would reach Egypt from the Nile. The volcanic flows of the Bayuda Desert have helped to produce the great bend below Khartoum. From here the six cataracts mark a more rapid fall in the valley until Aswan is reached. It is of much interest that the freshwater canal dug by the Caliph Omar 1,200 years ago is now 10 feet above the sea

at Suez, which gives us a fairly accurate measure of the upward movement in this corner of Africa²

The block-diagram sketched in Fig 46 shows the interesting topography of Egypt and the Nile. In Lawson's opinion the Sudd marks the infilling of a broad syncline while the cataracts and their gorges are cut in a recently warped upfold or anticline. Below Aswan the Nile flows in a narrow *Graben* or down faulted valley. This is not due to the cutting by the River Nile, but resembles in origin the gulfs at the north end of the Red Sea. The northern part of the 'Great Rift' is sketched at the Dead Sea, and also between Aden and Lake Rudolf.

If we accept the theory outlined above that the African drainage originally ran along north-south lines, then it seems probable that the changes occurred late in Tertiary times and were perhaps of the nature already described in the Australian sections. In other words although Africa was not folded during the world-wide mountain building, it may have been warped along a series of parallel corrugations. This would give rise to an alternation of lake-like expanses and raised water-gaps, which is just what the African topography suggests.

Commencing at the south we may postulate a N.W.-S.E. warp which beheaded the Orange River, led to the Ngami-Makari-Kari Lakes, and ultimately caused these waters to drain out to the east via the Zambesi. Then some 1,000 miles to the north another slight upward warp perhaps determines the Stanley Pool swamps at the mouth of the Congo, and the present divide between the Zambesi and Nile. Possibly a western extension of this warp has raised the Guinea coast.

The next up warp has turned back the Niger in the west (forming the Debo Lakes) and the Congo, in the centre, preventing its entry to the Chad Basin. The great Victoria Lake may also in part be due to the eastern end of this buckle. In the next trough we find the Chad Lake cut off from a possible Libyan outlet by another warp, here also are the Nile Lakes on the Bahr el Ghazal and possibly the great depression to the south of Algeria with the Gurara Lake, which may be part of the Proto-Niger. It is suggestive that these corrugations are approximately parallel to the Alpine-Himalaya folds and also to the Andean folds of South America and the central submarine Atlantic ridge.

The build of Africa, especially in the south, has led to its isolation

²The discussion given above is based on Schwarz *A South African Geography*

until modern times South of the fever stricken coasts of the Gulf of Guinea an enormous scarp—the edge of the greatly elevated African Shield—practically extends right round the continent as far as the Gulf of Suez. As a consequence of the scarp, all the rivers have cut great gorges in their paths from the plateau to the sea. These were very difficult, if not impossible, to traverse, and indirectly led to Africa being known as the "Dark Continent." Since railways have linked the ports to the plateau, the exploitation of Africa has progressed much more rapidly than that of Asia (see p 447)

B *The African Climate*

Africa is the only continent which exhibits a large extent of land reaching from tropic to tropic. It is thus especially suitable for a discussion of seasonal climatic changes, but the diversity of the topography and its rather variable width make it not quite so satisfactory as Australia in some aspects of the problem. As regards temperature, South Africa is greatly benefited by elevation, especially in summer (Fig 45). Since the land *rises to the south* it tends to become cooler, even though at this season we are approaching the overhead sun. An elevation of 5,000 feet cools the land about 15° F. The differences between sea level and plateau temperatures (in January) are shown in the section inset at the foot of Fig 45.

We may consider the climatic environment, especially the rain belts, as consisting of an *atmospheric shell* or layer which is attached to the sun. Since the axis of the earth is tilted at 23° to the ecliptic, the earth really rocks back and forth under the sun through an arc of 46°. We usually say that the sun moves from 23° N latitude to 23° S latitude, but the above statement is nearer the truth.

We may, therefore, imagine Africa to swing north and south under this atmospheric layer (Fig 47). This layer is not uniformly endowed with moisture but consists of a "Hot Rain Belt" approximately beneath the sun and very dry belts about 25° to north and south of the central position. On the polar sides of these two dry belts again about 35° away from the central belt, are temperate wet belts labelled "Light Winter Rains" in Fig 47. Africa is just long enough (north and south) to be affected by these temperate rains, as the continent "swings" to its extreme limits of movement.

The salient features of the climate of Africa can now be readily realized. In January the earth's tilt has moved Africa northward so that the sun is over Rhodesia (see Fig 47). (Actually the sun's

apparent "swing" is greater than the 'swing' of the rain belts so that the suggestion that the two are linked together must not be pressed too far) The Tropical Rain Belt is therefore, chiefly concentrated in Northern Rhodesia. All Northern Africa in winter is under the northern desert belt except Morocco, which is swung so far north that it reaches the fringe of the north temperate rain belt. The southern end of Africa is also experiencing desert conditions.

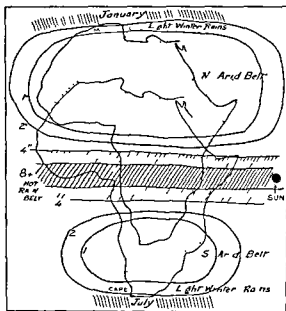


FIGURE 47—The seasonal swing of Africa beneath the sun and rain belts. The two arid belts actually extend far to the east and west.

In July the tilt of the axis brings Northern Africa under the sun. Guinea and Southern Sudan are now under the Tropical Rain Belt. The northern third of Africa is in the desert belt, and South Africa is chiefly under the other desert layer. But the tilt to the south has brought the southern tip of Africa into the south temperate rain region so that Cape Town and its vicinity get some rains in July (winter).

Thus the seasonal rainfall may be tabulated as follows

Region	Season of rain
Morocco, Algeria, etc	Winter only (January)
Sahara	Always in desert belt
Sudan	Summer only (July)
Guinea Coast and Congo	Almost always tropical rains
Rhodesia	Summer only (January)
Kalahari	Always in desert belt
Cape Town, etc	Winter only (July)

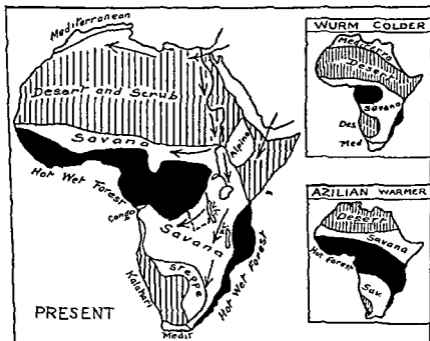


FIGURE 48—Diagrams indicating the vegetation of today, and the migration corridors (by arrows). Suggestions as to the vegetation in Wurm and Azilian times are given in smaller maps.

Actually, of course, the rainfall is not quite so simply arranged as Fig. 47 indicates. For instance, the Abyssinian highlands condense the rain by causing an upward deflection of winds. Further, the east coast of Southern Africa is wetter than indicated, because the constant onshore winds give moisture even in the desert belt. In the north, however, the great Asiatic lands effectually prevent any moist winds reaching the Sahara from the east.

Temperature conditions also swing back and forth, though owing to differences in topography and in distance from the sea the temperature "swing" is less regular than that of rainfall.

The most direct response of Nature to Climate is shown by the vegetation. This is shown in Fig 48. The dependence upon rainfall is complete. From the point of view of primitive settlement we may divide the regions into favourable and unfavourable as follows:

<i>Favourable</i>	<i>Unfavourable</i>
Savana	Hot wet forest
Mediterranean	Desert and scrub
Alpine	(Steppe)

We see that South Africa is separated from North Africa by a belt of hot, wet forest, which near Lake Tanganyika nearly joins the similar east-coast forest.

Some maps (e.g., Bartholomew's) make the forest belt reach quite to Lake Tanganyika, while another tongue of forest surrounds Lake Nyasa. So that a "corridor" only about 250 miles wide connects North and South Africa in these regions.

C Climates of the Past

If now we bear in mind the great changes in climate in fairly recent times (e.g., Wurm Ice Age and Azilian Age), we have to do with periods both colder and warmer than at present. The evidence in Africa has not been worked out yet, but in the annexed maps I suggest what may quite possibly have been the environment in Africa during these two extreme types of climate (Fig 48).

Thus when Neanderthal man lived in France in the Wurm Ice Age we may picture Africa as shown in the upper map. There would be a pleasant land in the North Sahara in which, no doubt, many primitive folk lived. Entry would be difficult into South Africa because of the continuous desert, even worse than at present. Any tribes which had previously reached South Africa would be free from attack from the rapidly developing peoples in Eurasia for the many thousand years of the Ice Age.

At the end of Palaeolithic times (the Azilian Age in West Europe) the conditions in France grew warmer and much more attractive. This moving north of the warm belts was certainly also evident in North Africa. In these Azilian times, possibly 15 000 years ago, the Sahara Desert extended much further north than today. North Africa may have been nearly deserted, but, on the other hand, there would be a much more attractive region in the middle Nile and Sudan countries in which Asiatic folk could readily expand from a fertile

Arabia, especially as the Red Sea may not have broken through at Aden at this time. This expansion of peoples would not probably affect South Africa for many centuries until cooling and desiccation had greatly constricted the forest belt, thus producing a corridor by which most of the peoples of South Africa entered their domain.

I think it probable, however, that small groups of primitive man had reached South Africa before the Wurm Ice Age in the form of Negroites and Neanderthal types.

Some of the most striking evidence of comparatively recent changes in the African climate is discussed by Penck.³ He points out that on Mount Kenya are extensive ancient cirques 14,000 feet above

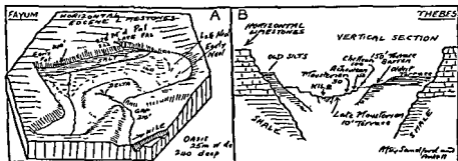


FIGURE 49 A.—Block diagram of the Fayum Oasis 50 miles south-west of Cairo. Shore-lines occupied by prehistoric man are indicated. Feet above lake floor are given.

B—Vertical section across the Nile Valley at Thebes showing prehistoric sites

sea-level, while Gregory found old moraines at 10,000 feet. His conclusion is that the snow-line has ascended 4,000 feet since the Ice Age, which probably indicates a warming of 10° or 12° F. On Kilimanjaro are similar traces of lower-level ice sculpture.

In the Sahara the ancient river channels and river alluvials prove that at their sources there was fairly recently a much better rainfall than obtains today. (We must remember that if the Nile should cease at Khartum, the deep river valley at Cairo would not indicate bygone humid conditions on the Lower Nile but at the head-waters) The shotts of Algeria are extremely salty, while "pans" (or hollows due to arid erosion) nearer to the centre of the Sahara are quite empty. But west of Air the flat pan of Tesellamen is occasionally flooded, while the Lake Chad Basin is only slightly saline and contains fish similar to those in the River Shari.

³In the *Scottish Geographical Magazine*, 1914.

There are many empty pans found in the South Kalahari, and in North Cape Colony are typical salt pans (playas). In North Kalahari, on the other hand we find the great Etosha Pan (250 miles from Cape Frio) in which freshwater fish can exist.

Penck, therefore, draws the general conclusion that on the equatorial side of the great deserts are flat pans occupied with slightly saline or fresh water, while on the polar side occur strongly saline lakes. Again in the north of the Sahara are *living* dunes of bare wind-blown sand, while to the south *dead* dunes, fixed by sparse vegetation, border the desert on the equatorial side. The latter stretch far into

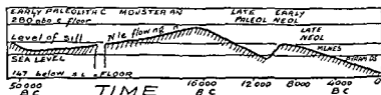


FIGURE 50—Changes in level of lake in Fayum Oasis during period from 50 000 B.C. to A.D. 0

the humid territory of the Niger Basin. In the Kalahari the dunes are mostly "fixed," especially on the northern side. All this leads us to assume that the area of extreme aridity in Africa once lay much nearer the Equator than it does today, exactly as is found to be the case in America. (I have elsewhere shown that this is indicated in Australia also.)

Penck strongly supports the view that a general lowering of temperature, i.e. a decrease in the earth's heat supply rather than an increase of rainfall, was the chief cause of the Ice Age and of its chief phenomenon, the *shrinkage of the tropical zone*. In the interglacial periods the converse occurred and laterites (implying alternating wet and dry seasons) were formed right up to the desert edge.

Evidence of climatic change is abundant in the great oases of Egypt. These lie at the foot of great hollows gradually eroded by the steady northern winds in the rather friable sandstones and limestones (Fig. 49). The data at Fayum have been investigated by Caton Thompson and Gardner.⁴ Here a large lake has been filled by the Nile in very wet years, and has gradually dried up in dry years. Primitive man usually made his dwellings at the water's edge. It

⁴Royal Geographical Journal, Jan., 1929

appears that the lake was filling during Mousterian times, say up to B C 16,000, when it was about 280 feet above the lake floor. It shrank again during late Palaeolithic times till it was below sea level. The lake rose again during early Neolithic times, but has been shrinking more or less continuously since about 9,000 B C (Fig 50)

The most striking of these wind eroded hollows in Egypt is the Quattara depression. This lies 150 miles to the west of Cairo, and is 200 miles long and up to 900 feet deep. It is not too much to say that this natural "trench" saved the British army at El Alamein in July, 1942 (Fig 45)

Recent work by L S B Leakey⁵ and others makes it possible to correlate the deposits found near Nairobi (in Kenya) with those investigated so fully in Western Europe. Hence we obtain clues to the corresponding climates and cultures in both continents

<i>Date</i>	<i>Africa</i>	<i>Europe</i>
B C 850 to B C 0	Nakuran Pluvial	Sub-Atlantic
B C 2 500 to 850	Dry	Sub Boreal
B C 10 000 to 2 500	Makalian	Bühl Ice
?	Dry	Achen (warm)
B C 40 000	Upper Gamblian	Wurm Ice
?	Lower Gamblian	Riss Ice
?	Dry	Mindel Riss (warm)
B C 400 000?	Kamassian Pluvial	Mindel Ice

⁵*Stone Age Culture of Kenya Colony* (Cambridge, 1931)

CHAPTER IX

AFRICA—ETHNOLOGY¹

The first point of interest in studying the distribution of the African peoples is that the same rule holds good which we have observed in the Australasian peoples. The most primitive groups are found in the regions most distant from Asia or what comes to the same thing in the most inaccessible regions. If we refer to Fig 48 we shall see that the inaccessible regions for the traveller from Asia are the centre of the Congo forest and the Kalahari Desert.

Two important criteria stature and hair-character serve to separate the tribes in these regions (shown in Fig 51) from the remaining peoples of Africa. In the Congo forest are the most primitive Negroes. Tribes with allied characters are found all along the Equator in the Congo forests and also in the isolated forests just to the east of Victoria Nyanza.

In the Kalahari Desert and adjoining are the Bushmen who have the same hair as the Negroes and are also very short people. There are however important differences which can be most readily explained by assuming that the Bushmen are not a pure race but contain a proportion of pygmy blood. Another complex group is the Hottentot race which will be considered in some detail later.

The chief ethnic boundary in Africa is the line which separates the Negroid peoples from the Hamitic and Semitic folk of Mediterranean race. It is by no means a clear cut line but speaking generally there are marked changes in head shape hair texture nasal index proportion of limbs skin-colour and language to the north and south of this boundary.

We may now compare the distribution of peoples in Africa with that of the peoples in Australasia. There is seen to be a very close similarity in the arrangement of these peoples (Fig 52). This is I believe what we should expect if we realize that we are dealing with exactly the same phenomena in each of the peninsulas projecting from Asia. South of the Equator both in Africa and in Australasia the environments are naturally arranged in similar zones according to latitude.

¹For typical photographs see Plate II nos 19 20 and 22

Given these conditions, it seems logical to assume that the racial zones can only have resulted from similar peoples spreading out like waves from a common origin. This "cradle-land" should be approximately between the two "peninsulas," and all indications (as we shall

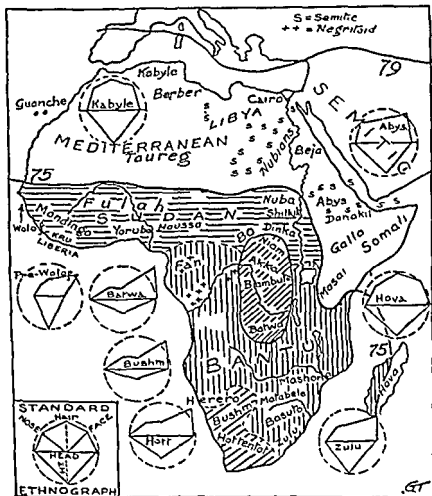


FIGURE 51.—Races of Africa with ethnographs. Lines with numbers show average cephalic index.

see when we consider the racial distribution of India) point to a region of maximum evolution not far from Turkestan. It is not unlikely that the time factor was similar in the spread of these peoples. If they were all affected, as I believe, by successive climatic thrusts of world-wide significance, then it is at least possible that the Tasmanian

reached his island about the same time that the Bushman reached South Africa, but this is at present too speculative a theory to be worthy of more than mere mention (Fig 52)

RACE PARALLELS IN AFRICA AND AUSTRALASIA

<i>Environment</i>	<i>Race</i>	<i>Cephalic index</i>	<i>Africa</i>	<i>Australasia</i>
(a) Hot wet forests	Pygm es	Variable	Batwa etc (Negritoes)	Tap ro Aeta (Negritoes)
(b) Cooler lands in extreme south	Negrito hybrids		(Bushmen?)	Tasmanians
(c) Equatorial forests and park lands	Lower Negro	71	Peoples of Guinea and Upper Nile	New Guinea South Melanesia
(d) Cooler park lands	Higher Negro	73	Bantu speaking Negroids	Australoids
(e) Regions just to east of Region (c)	Mediterranean	75-7	Ethiop ans Berbers	Nesios Higher Melanesians
(f) Islands farther to east	Early Alpine types	80+	Antimerina of Madagascar	Later Polyne sians

A Prehistoric Man

The discovery of several ancient skulls in South Africa might seem to imply that this was the cradle land of man. But the 'Zones and Strata Concept' proves that primitive folk survive longest *far* from the cradle land. In this connexion some mention should be made of the Taungs skull (found near Kimberley), which seems to be allied to the extinct Strand loopers of South Africa. The Broken Hill skull (Rhodesia) is a generalized type linking Neanderthal man, Negroes, and Australoids. It probably represents the ancestor of all three. These primitive types are discussed further in section G.

B The Bushmen

The origins and affinities of the Bushmen are not well understood. They are distinguished from the general type of African Negro by the

fact that their cephalic index is much higher, i e , their heads are much broader, and by the fact that they are orthognathous, i e , the jaws do not project forward Further, the skin is yellow and so pale that a blush may at times be perceived¹ In other respects they are extremely primitive They have "peppercorn" hair and short stature (4 feet, 2 inches, to 4 feet, 10 inches) Steatopygy, i e , large buttocks (especially in women) is very pronounced The writer believes that the Bushmen originated as a hybrid between the first migration into Africa (the Negritoes), and various later migrations Their habitat so far from Asia shows us that they also represent a very early migration Their language is unique, for they use "clicks" in addition to vowels

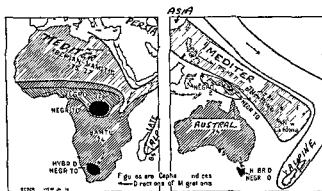


FIGURE 52—The remarkable similarity in the race-zones in Australasia and Africa—showing their common origin. N B The Bantu are not akin to the Australoids

There are four or five such sounds which are made by the tongue against the teeth or cheeks, etc , and are akin to those used by white folk to urge a horse to greater speed

In their culture the Bushmen had no animals and grew no crops They were in the primitive hunting stage, and resemble in so many ways some of the Aurignacian folk of Western Europe that Sollas and others have little doubt of their being of the same race Customs, weapons, steatopygy, small stature, and especially the artistic work of the two groups, are exceedingly alike In Fig 53 it is suggested that the similarity in the pictures found at Cogul (Spain), in the present Bushmen territory in South Africa, and at Raigarh (340 miles west of Calcutta) is due to their common origin We may imagine these Negrito people spreading from a cradle land (between the three regions mentioned) and carrying the culture independently to Spain,

South Africa, and India. Indeed some relics of Negrito folk are reported from the Caucasus area.

The Bushmen of Southern Africa² are reduced to about 26 000 of whom more than 2 000 inhabit the former German territory. There are about 4 000 of the pure San race in Cape Colony along the Orange River. The Kau Kau are about 5 000 in number on the east of the late German territory. These are small and unmixed. Near Ngami are 5 000 *halahari* Bushmen and just to the north are 10 000 tall black-skinned Bushmen who are mixed with the Bantu.

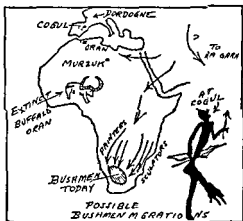


FIGURE 53—Suggestions as to the migrations of the Bushmen. Great similarities exist between wall paintings at Cogul (Spain) and in South Africa.

Far to the north near Mount Elgon (Uganda) a dwarfish type is met with, some 4 or 5 feet high, in great contrast with the Turkana just to the north who are often 7 feet high. These folk and similar dwarfs among the Dorobo of East Africa and Doko of South Ethiopia suggest the Bushman type rather than the Congo pygmy³. They are vestiges showing the route of the Bushmen, just as the Semang in Malaya show the corridor along which the Tasmanian marched.

C The Hottentots

The Hottentots differ from the Bushmen in being taller and intermediate in bodily structure between the Bushmen and the true

² Sir Harry Johnston *Britain Across the Seas: Africa, A History and Description of the British Empire in Africa* (London 1910) p. 249.

³ *Ibid.* p. 404.

Negroes Johnston considers that they result from a mixture of the Bushmen with some Nilotic Negroes, which occurred so long ago that the type is now well established. Some authorities, however, believe that the Hottentot language, in its inflexions for number and gender, etc., shows affinity with the Hamitic languages, so that they possibly incorporate much higher blood than that of the Nilotic Negroes. The Sandawi of former German East Africa speak a kindred language. However, steatopygy, pale colour, and clicks in the language ally them to the Bushmen, while the head index (74) may be due to a merging of Bushmen (77) with Negro (72) or may be evidence of some northern Mediterranean blood (75). Most ethnologists consider them to be a cross between Bushmen and Bantu, with possibly some early northern admixture. Moreover, their cattle are the long horned type from north east Africa, while the surrounding Bantu have only small horned cattle.

Their distribution around the Lower Orange River is shown in Fig 52. But when the Boers invaded the Bushmen territory just to the north, the Hottentots moved with them. The Nama tribes dwelt on the coast and are the purer stock, the Korana have nearly died out, but occupied the Upper Orange and Vaal. There are said to be about 200 000 Hottentots and half castes (Griqua with Berbers, and Gonakwa with Kafirs) in South Africa.

Of particular interest, as linking the southern primitive people with the forest pygmies, are the *Strandloopers* of Natal and the *Vaalpens* of Central South Africa. The former are long extinct, but their relics occur in caves along the coast.

The Vaalpens were described by a French traveller, Delegorgue, in 1847⁴. They were said to have a much darker skin than the Bushmen and to live in holes carved out of huge ant hills. They were cannibals and had more abundant head hair, while the men had thick beards. Their height was barely 4 feet. In all these particulars they differ from the Bushmen and come very close to the Congo pygmies. It is quite possible that a few of the latter fled south before the Bushmen instead of penetrating the thick jungles of the equatorial forest.

D The African Pygmies or Negritos

Apart from their short stature, these pygmies differ in nearly every respect from the Bushmen. They are usually much darker in colour,

⁴*Ibid* p 41

reaching chocolate tints. The hair is less kinky in the pygmies and is said to be brown at times. The body is covered with a fairly thick down. Steatopygia is rare but the two races have similar noses. The height of the pygmies is much less, the average for thirty Akka being 136 cm. and of ninety-eight Batwas 142 cm. (Bushmen average 157 cm.) The pygmies vary considerably in cephalic index but it seems in many cases to be 79 or 80⁴.

Their habitat extends across Central Africa. The Akka Wambutti and Afiffi live to the west of Lake Albert, the Batwa to the south of the middle Congo, the Babongo and Akua in the French Congo. The Bayago and Babengaye of the Cameroons are other tribes who belong to the pygmy peoples. Less isolated by thick forests are short mixed peoples who live in the east near Lakes Rudolf and Tanganyika. They may possibly have Bushman rather than Negroito blood.

E The Negroes of Africa

This zone of peoples occupies practically the whole of Southern and Central Africa and much of Northern Africa up to the centre of the Sahara. This is a climatic region on which on the whole is not at all attractive to other races, and hence we find the Negro peoples suffering less from displacement than perhaps any other primitive races. All along the northern boundary they have been penetrated for centuries by inroads from the Mediterranean peoples of the north but the vast central and southern block of Negroes has not been greatly affected by recent race mixture.

The African Negroes may be classified by physical differences into two or three groups: the true Negro who has also been called the Western Sudanese, the Nilotic Negroes, and the Bantu speaking Negroids. Probably the last two should be classified together. The true Negro is of sturdy build, tall stature, and a dark brown or black skin. The Nilotic Negroes live along the Upper Nile in the Sudd Basin (Fig. 46). They are extremely tall, very narrow headed, and have retreating foreheads. They are very slimly built, and the skin is extremely dark. There is considerable variety in the third group: the stature is less tall and the head usually dolichocephalic, although certain mesocephalic groups do occur, and they have not that elongation of the head which is often so characteristic of the true Negro. The forehead is differently shaped, the jaw less prominent, and the

⁴See photo 20 Plate II

nasal index is lower. The lighter colour of the skin is also a distinctive feature. It seems probable that the Bantus represent a cross between true Negroes and Mediterranean stocks.

The Southern Sudan shows more racial merging than almost any other part of the world. This is partly due to the tolerant Moslem creed which is almost free from "race prejudice." Hence there is here a large number of types (like those which occur among the people speaking Fula, Mandingo, Hausa, or Masai) who show mingled Negro and higher characteristics. The Negroes belong to two linguistic classes—the very variable northern group, and the well defined Bantu group of the south. It seems likely that the West African tribes represent the ethnic stratum next above the Bushman and Negrito tribes which have just been considered.

The "divide" between the Negro and Mediterranean races is described as originally extending from Cape Verde to Massowah *via* Timbuktu, Lake Chad, and Khartum. The inrush of Galla and other higher tribes has, however, pushed it south, so that it now extends down the Nile to Lake Albert and Lake Victoria, and thence across to the Juba River. All along this boundary the true Negro has adopted much of the culture of his aggressors, so that we find the not uncommon anomaly of very primitive folk with primitive languages having much greater command over the arts and crafts than is the case with many tribes, apparently of later racial development, to the south. Some far reaching "Negro Empires" developed in the Sudan due to this admixture with the higher civilizations, but farther south these Negroes, where unaffected by outer culture, are infinitely below the untouched Bantu in their outlook on life. Cruelty, superstition, and ignorance have nowhere worked such evil as among the coastal tribes of West Africa.

In the extreme west, as we should expect, are some of the most primitive of all, of whom the Wolofs of the Lower Senegal may be taken as a type. They have extremely black skins and are very tall. A stature of 6 feet, 6 inches, is common at Dakar. The head is markedly dolichocephalic with an index as low as 89. Another primitive feature is the complicated language (there are said to be twenty four forms for expressing the "definite article"), though similar absurd complexity was considered by the early Aryan philologists to be a mark of late evolution!

The Mandingo peoples inhabit French Guinea and Sierra Leone, and allied languages extend far east to the Fula territory. They are

skilled craftsmen and agriculturalists and were the founders of the ancient empire of Guinea, which was of great importance in the Middle Ages. They are fervent Mahomedans, and as an example of their enterprise we are told that a pilgrimage of 60 000 journeyed to Mecca in 1331, but practically all died from disease in the oasis of Tuat (south of Algeria).

One of the most interesting regions in Africa is Liberia, which was founded in 1820 as a means of settling freed American slaves. There was no real white control until 1909, when the United States took charge of the finances, and the history of Liberia has consisted of ludicrous political struggles between the freed slaves and native Negroes.

The peoples of the Lower Niger are typical Negroes—black skinned, tall, big bodied, with projecting jaws, flat noses, and long upper lips. It is the Negro type in its most pronounced and exaggerated development. Even down to very recent times these tribes were much addicted to cannibalism. Their religious beliefs were closely associated with the incessant shedding of blood and reached a climax in the abominable practices of Benin.⁶

The Nilotic Negroes of Eastern Sudan are much intermingled with Ethiopian peoples, but in Darfur and the region of the Ghazal and Djebel Niles there are pure Negro or rather Negroid tribes. Among these are the Shilluks, who have mixed with the Hamites (north west of Fashoda), who number about a million. Along the Djebel Nile to the south of Lake No are the same number of Dinka, while expert metal workers like the Bongo live on the slopes of the Upper Ghazal to the south west. These peoples are probably physically akin to the Bantus.

F *The Bantu Negroes*

This great group of peoples is united by a common type of language, more closely related than are the Aryan tongues of Eurasia. Seeing how rapidly speech varies amongst people without a fixed literature and a high civilization, it is remarkable how close this relationship should be among all the types of Bantu speech between the Cameroons and Natal. This would seem to show that the original date of the dispersion of the Bantu languages over the whole of the southern third of Africa must be relatively recent, perhaps not much more than 2 000 years ago.⁷ The syntax of the Bantu speech is marked

⁶Johnston *op cit*, p 337

⁷*Ibid*, p 44

by dividing objects into seventeen groups, each with appropriate 'declensions' Particles are characteristically *prefixed* to the roots instead of suffixed as in most Aryan words Thus "(k)ntu (k)ema" means 'a good thing,' while '(b)ntu (b)ema" means "good things" A similar method obtains in the extreme west of Tropical Africa, showing some affinity between the Negroes of the western and southern wings' of the Negro migration

The history of migrations into Africa may be dwelt on at this stage in our study The zonal distribution seems to indicate that the Negritoes and Bushmen were the first-comers Next came the main body of true Negroes who have kept to the hot forests for the most part These are certainly of different stock from the broader headed, lighter-coloured Bushmen Then on the north east of the Sudan and Guinea Negroes we find the Bantu and Sudan (Nilotic) Negroes

Probably the chief stimulus determining the later migrations in Africa was the invasion of North Africa by the Libyan and Berber tribes from the east These people are akin to the Mediterranean folk of Southern Europe, and we can get some idea of their arrival in North Africa if we realize that it almost certainly long preceded the arrival of these "Iberians" in France and Britain

Now Magdalenian man in France is by some authorities allied to the Libyan Berber population of Africa The period of Magdalenian man in France was the last minor Interglacial period which may be set down at some twenty thousand years ago It seems to me that this date is not too far back for the entry of the Libyan people into Egypt

At that time there were many of the dwarfish stock in Upper Egypt who were supplanted and absorbed by the Libyans, together with large numbers of the Negro peoples From these elements were built up the early Egyptians, who some ten thousand years ago were advanced enough to leave permanent relics of an important Neolithic civilization

Johnston places the cradle of Bantu speech to the north west of Uganda He thinks that the Bantu remained there until iron and copper weapons gave them a tremendous advantage over the southern tribes Thus two thousand years ago they started on their last great advance and reached the Cameroons and the great lakes By about the seventeenth century they had conquered almost all Africa between latitudes 3° N and 25° S

It seems clear that these great Bantu migrations were controlled by an aristocracy relatively few in numbers who were members of

this higher type, intermediate between Negro and Hamitic. The Fula people seem to be akin to this "aristocratic" Bantu type.

The Bantu people are generally distinguishable from the Niger Negroes by somewhat lower stature, broader heads, and less prognathism. The nose is more prominent and narrow. There are numberless tribes whose names often begin with the prefix *Ba* (denoting many), *cf. Ba ntu*. Thus the *Balolo* live in the bend of the Congo on the south side and comprise ten million people. They are skilful ironworkers and laid out their towns with very symmetrical plans. Across the Congo to the west is the large group of *Fan* tribes, a tall slim people with marked Mediterranean features and resembling the Fulah of Nigeria. They were, however, cannibals.

On the east coast in the Zanzibar region, the Bantu have mingled with the Arabs and speak Swahili, which is a *lingua franca* in east and central South Africa. The Bantu inland from Zanzibar have been much affected by the powerful *Masai* tribes living just east of Victoria Nyanza. This famous race invaded the Bantu countries south of the Equator some three or four hundred years ago and extended their settlements as far as 7° S latitude. They speak a language allied to the Nilotic speech.

The Bantu best known to us are found south of the Zambesi. In Southern Rhodesia are the *Mashona* and *Matabele*. To the south-east of Lake Ngami are the *Betchuana*. In Damaraland are the *Herero*. North of Natal was the home of the *Zulus*, and in the mountains to the west are the *Basuto*.

The *Mashona* belong to the Nyanza (Lake) group of Bantu. They are settled agriculturalists who have been easily dominated by *Zulus*, *Betchuana* etc. In the eastern portion the women insert a flat ring (*pelele*) into their upper lip.

The *Matabele* are Zulu people who fled from Chaka in Natal early in the nineteenth century. Led by Moselekatse they ravaged the *Betchuana* and ultimately settled north of the Limpopo. Later they attacked the Rhodesian settlers.

The *Betchuana* and *Basuto* are closely allied in appearance and language. The northern tribes under their ruler Khama are flourishing, largely because they prevented alcohol from entering their territory.⁵

The Zulu *Kafir* peoples are the most southerly of the Bantu peoples. The term *Kafir* was applied by the Arabs and means "Un-

⁵Johnston *op cit*, p 244

believer' The name is now applied only to the Zulu people on the boundary of Cape Colony They differ little from the Swazi and Zulus to the north

The history of recent Zulu migrations is typical of many of the race movements in Africa In 1787 was born the Zulu Chaka He learnt something of the military discipline of the British (from Dingewayo) and then attacked the northern Zulus The girl captives became wives of the conquerors, the youths entered his army All the remaining hostiles were killed From 1819 to 1893 all the south east of Africa was bathed in blood owing to the aggression of tribe against tribe But in 1893 Dr Jameson defeated the Matabele, and since then peace has come to the Bantu

G *Neanderthals, Negroes, and Australoids*

All anthropologists adopt the Negro as one of their major classes It is almost the only point of general accord But the present writer has been endeavouring for many years to develop a reasonable theory of Negro origins, and the next few pages are taken from an article which he published in *Human Biology*⁹ Are there any relics of the ancestors of the Negroes? Has their hot environment any bearing on their evolution? It is logical to expect to find some clues to their ancestry in the "strata" underlying the relics of the present Negro races in Africa, or below the Mediterranean race in Europe, Africa, and Asia Such data occur even in Asia, for Guha and Basu¹⁰ mention several 'inliers' of tribes where "crepe" hair is to be observed among the Nagas in Assam and also in Cochín Furthermore, Mansey has described "Melanesoid" skulls from Tonkin¹¹

Western Europe is the only region which has been moderately well investigated as regards Palaeolithic times Here we find an almost universal "stratum" characterized by Neanderthal man, followed by Cromagnon, Combe Capelle, and Grimaldi man Not many years ago it was customary to state that Neanderthal man had died out, and that no living races had descended from him The writer believes that later evidence is disproving this statement In the first place, Neanderthal man seems to have been a distinctly variable person

The skull from Ehringsdorf (1925), although dating from Pre

⁹Baltimore, Sept 1936

¹⁰In *Anthropos* 1932 p 162

¹¹See von Eickstedt, *Rassenkunde* (Stuttgart 1934) This is the most complete of modern studies of the Races of Man

Wurm days, had a loftier vault, thinner walls, and a more vertical forehead than many later Neanderthal types. In Keith's words¹² already he approached modern man in these respects. One of the most primitive skulls of all comes from Broken Hill, Rhodesia—yet Smith Woodward links it with the Australoids. At Predmost (Moravia) twenty skeletons of Aurignacian culture are described by Keith as having large heads, with palates rivalling the Australoid, and in their long, high skulls reminding one of the "negroid features of the Combe Capelle type." The Galilee skull¹³ also exhibits features linking Australoid and Negro skulls to Neanderthal, especially as regards the frontal bones and the height of the vault. Sarasin¹⁴ is emphatic that living Negroes from New Caledonia as regards the orbit, jaw, nose, and humerus are *more primitive* than the Neanderthal type.

Von Eickstedt¹⁵ corroborates the view put forward by the writer in 1919. He states that the Aurignacians of Europe show a great similarity with recent Australoids, and the resemblance also obtains with Neanderthal man, but to a less degree. In his opinion, the Aurignacians are somewhat less primitive than the Australoid, as regards prognathism, face, and skull base, but are extraordinarily alike as regards body shape, length of skull, shape of chin, etc. In Capetown in 1929 a skull was dug up from a depth of four metres which again links the European Aurignacian type with the Australoid in von Eickstedt's opinion.

Since so many writers have demonstrated that a series linking Cromagnon to Combe Capelle and to Neanderthal is gradually being discovered,¹⁶ there seems no good reason to doubt that Neanderthal man was physically as near to the ancestor of his successors as we could reasonably expect to find in a *marginal* region. An analogy with Greenland may make this clearer. Suppose anthropologists had only evidence of a *marginal* colony like Greenland to help them in their reconstruction of Scandinavian history. They would find skeletons and artefacts to help them to elucidate Scandinavian history from A.D. 1000 to A.D. 1450. Then right from 1450 to 1700 (when Egede made another settlement) there was an absence of Scandinavian man and culture in Greenland. The new culture after 1700 seemed entirely

¹²*New Discoveries Relative to Man* (London 1931)

¹³See *ibid*

¹⁴*L'Anthropologue* (Paris 1924)

¹⁵*Op cit*

¹⁶*Cf* von Eickstedt *op cit* p 425

dissociated from that of the early Norsemen. But elsewhere, i.e., in the cradle land (here Norway), the sequence was unbroken. So also West Europe was a *marginal* land receiving interrupted migrations, and the complete picture of the racial and cultural evolution of Neanderthal man is obviously to be sought in *Southern Asia*, not in Western Europe.

Let us once more return to the topic of living descendants of Neanderthal man. Most convincing is the description of an Australoid woman who died only a few decades ago in Eastern Australia. Burkitt and Hunter give fourteen Neanderthaloid features in this skull.¹⁷ Indeed in the regions of the torus and bregma they notice affinity to *Pithecanthropus*! The writer believes that it is precisely because the Negro was thrust into the stagnant environment of the tropics (of Africa and Melanesia) that he preserves so many primitive features. Of course he has evolved somewhat since his early arrival in the tropics perhaps 100 000 years ago. But meanwhile in other stimulating areas racial evolution has been much more striking and has left him far behind. His 'paired' environments (in Africa and Melanesia) are indicated in Fig. 101.

The writer in 1921 in a large coloured chart of nine maps showed his conclusions as to the evolution and migrations of races. The relative position of Negroes and Australoids is a little difficult. In both there is a wide range of characters. Thus in Australia the writer has investigated most of the coastal regions and here the aborigines in general are much less "primitive" in appearance than those from the central deserts, made familiar by Spencer and Gillen's splendid books.

Apart from the hair, there is no very striking difference between the Australoids and Negroes. But hair texture is universally admitted to be of great importance—and in the Australoids it is almost universally *wavy* rather than curly, and never frizzy. This places them biologically nearer the central racial zones (Mediterranean and Alpine). It is of interest that Sarasin records that the newborn New Caledonian Negro has wavy hair which is replaced after the first week or so by the usual kinky Negro hair. So that kinky hair is possibly a secondary character acquired by Negroid peoples.

If we turn to the ecological evidence then it seems clear that the Australoids migrated out of Asia much later than did the Negroes. Thus Mitra¹⁸ writes 'India shares with Africa Proto negroid begin

¹⁷*Journal of Anatomy* Cambridge 1922

¹⁸*Prehistoric India* (Calcutta 1927)

nings and with southeast Asia the *superimposition on them* of Proto Australoid elements. There are now no Negroes or Negritos on the mainland except in Perak (and perhaps in the top of India). But there are millions of Australoids (the so-called Pre Dravidian tribes) in the eastern hills of the Deccan in India and in Ceylon so that we may surely say that their less marginal position agrees with the hair-character and places the wavy Australoids a little higher than the frizzy Negroes of Africa or Oceania.

My suggestion is that a Neanderthaloid type lived in Southern Asia and gave rise to the Negroes far back in the Pleistocene—perhaps in the Gunz Mindel Interglacial (Fig 98). The Mindel Ice Age drove most of them to the south west—whence later they reached Africa. Somewhat doubtful inliers of Negroid folk have been described from Susa (Persia) and from south east Arabia. Fewer went to the south east and so ultimately gained Papua and Melanesia. The Semang of Perak and possibly some tribes in Assam support this hypothesis. It is little use speculating as to change in hair character which probably now developed in the cradle land but I picture the next migration as consisting of Australoids—most of whom went into India or to the south-east and so reached Australia. Possibly their cradle land was farther to the east in Asia than was that of the Negroes.

In Upper Tonkin seventeen skulls of Australoids akin to those found in the Aurignacian in Europe are mentioned by von Eickstedt. Many of the people living in Western Europe about B.C. 20,000 were very like the Australoids and Sir Harry Johnston draws attention to the Australoid appearance of the Ushtettas still living in the mountains of Algeria. It seems likely that some Australoids reached America in one of the Interglacials—probably the Riss Wurm Interglacial.¹⁹

¹⁹For further references see the paper in *Human Biology* op cit

CHAPTER X

THE HIGHER RACES IN AFRICA

A The Fula People and Their Empires

To the north of the country of the Sudan Negroes lies a most interesting region extending between latitudes 9° and 17° N which is inhabited by the most progressive of the Negroid peoples. They are usually assumed to be hybrids between the Mediterranean race and Negroes. Of these peoples the Fula tribes are the chief. Their language has many suffixes akin in character to the Bantu prefixes. Thus *Ful be* = Fula people *Ful de* = Fula language. The pure Fulas are a handsome, tall light skinned people with hair growing in ringlets.

There are many lands suggested as the source of the Fula people. One story places it in the highlands behind Cape Blanco, whence they were driven by Libyans down into Senegambia. Other stories say they came from Fezzan (south of Tripoli), or from Arabia, or even from Persia and Egypt as the dispersed army of Cambyses (500 B C). We are dealing with what is today a union of many diverse stocks, and whatever may have been the habitat of the main Fula people, probably strains from all the above cradle lands are associated in the Fula tribes.

Their chief interest to the student of Anthropogeography lies in the fact that in Western Sudan grew up great empires which rivalled in extent the empires of Charlemagne or Napoleon, and yet in Africa white folk were ruled by black monarchs belonging to these Fula races.¹

During the seventh century the Arabs under Okbar conquered North Africa and in A D 666 he reached nearly to Lake Chad. As a consequence of these raids the Berber (Hamitic) people of Mauretania were driven south and a great mixture of peoples arose on the southern edge of the Sahara. The culture of the peoples along the Niger seems to have been derived very largely from the Spanish and Moorish kingdoms, and, in fact, Timbuktu was more closely in touch with learning than were many of the north western countries of Europe during the early Middle Ages (Fig 54).

In 757 Tafilet was founded by these black peoples in the Atlas region as the northern trading outpost of the Fula peoples whose

¹I have based this account of the Melle and Songhay Empires on that very interesting book *A Tropical Dependency* (London 1905) by Lady Lugard

capital was at Ghana, some 350 miles west north west of Timbuktu (Later this name was replaced by *Awalatin* (or *Valata*) and again by *Biru*) By the European the kingdom of *Melle* (or *Mellestine*) was usually reached *via* *Taflet*, for during the eighth and ninth centuries the *Tripoli* route seems to have been too arid

In 1055 certain Moslem Berbers who lived near the Senegal sacked the pagan city of Ghana and then, marching north, ultimately con-

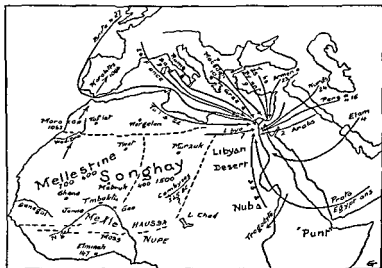


FIGURE 54—The Fula Empires of North Africa and the invaders and rulers of Egypt The figures show the order of invasion into Egypt

quered the south of Spain (These Morabite Tauregs founded Morocco in 1062 and Timbuktu in 1087) In 1153, however, Ghana was still ruled by pagan blacks, who dealt fairly with Moslem traders in their midst

The great kingdom of Melle extended from the Atlantic to 6° E longitude On the north it reached the foothills of the Atlas and nearly to Ouargla (Wargelan) On the south it extended to the unhealthy forests and swamps of the West Coast hinterland The artesian wells of Tuat were in the Melle kingdom, and the empire increased in power and renown to the fourteenth century The emperors made pilgrimages to Mecca, and in 1337 the Moslem king of Morocco sent an embassy with presents to his powerful black

rival the king of Melle In 1352 the famous traveller Ibn Batuta visited Melle and records that "the blacks do not confiscate the goods of the white men who die in the country even though it may be a question of immense treasure" In fact, Berbers and blacks enjoyed perfect equality

Meanwhile another group of Fula peoples had founded Gao on the Niger, some 300 miles east of Timbuktu, and both these towns were conquered by Melle early in the fourteenth century But by 1355 the Songhay peoples of Gao were coming to the front They are described as possessing the gentle nature of the Sudanese combined with the virility of the Arab, inoculated with intellectual germs of a long forgotten civilization In 1468 they took Timbuktu, and in 1477 the large town of Jenne, 200 miles up the river We are told that the learned black professors of the University of Timbuktu had dwelt so long in comfort that they fell off the camels which were to carry them to safety in Aiwalatin¹

Under Sonni Ali and his successor, Askia the Great, the Songhay Empire extended throughout Mellestine and far to the east to Augila (in Barca), Tibesti, and Lake Chad But events in Europe so altered the course of trade and civilization that Songhay was left in a back-water in which it gradually stagnated In 1471 the Portugese landed at the port of El Mineh ("The gold mine") In 1492, the year of Columbus's great discovery, died Sonni Ali, and in 1497 Vasco da Gama rounded the Cape of Good Hope 'The Sudan of the Arabs was visited no more by the outer world, and a civilization in touch for nearly a thousand years with the most highly cultivated centres of European life was silently buried in the sands of Africa "

B *Early Egypt—its Races and Invaders*

Uncivilized Palaeolithic man occupied the basin of the Nile before the rich desposits of silt were laid down Possibly the rainfall was heavier and the current swift enough to wash the silt right to the sea Nowadays this silt region is larger than Belgium It is 33 feet deep and assuming a deposition of 4 inches a century, it therefore started ten thousand years ago At any rate, *rude flints of early Palaeolithic* appearance are scattered on the uplands and long antedate the earliest civilized relics of about 8000 B C

Recent investigations by Sandford and Arkell² in the valley of the

¹Prehistoric Survey Expedition University of Chicago 1928 A pygmy skeleton has recently been reported from 200 miles south of Khartum

Nile near Thebes have shown that Palaeolithic man lived here since the river was cutting out the 100 foot terrace (Fig 49 B) There are still higher terraces but no flint implements have been discovered at these earlier levels Thus crude hand axes and allied implements were found on the 100 foot terrace similar to those known as *Chellean* in France As the river cut down into the silts it left terraces at 50 feet (which contain later *Acheulean* implements) and at 30 feet which exhibit *Mousterian* tools Hence we are reasonably sure that Neanderthal man lived here some 40 000 years ago

In the deep basin occupied by the Fayum Oasis (Fig 49 A) Caton Thompson and Gardner have found early Palaeolithic implements 140 feet above the lake floor Middle Palaeolithic and late Palaeolithic tools were found still higher as shown in the sketch indicating that the lake was rising (Fig 50) Early and late Neolithic relics show that the lake was gradually receding to a depth of about 140 feet At this stage Herodotus knew of it as Lake Moeris about B C 400

There is some rather indefinite evidence of a stratum of folk allied to the Bushmen having occupied Egypt before the arrival of the slender brown race who still constitute the bulk of the population Artemidorus (270 B C) describes the Troglodytes of the eastern desert as nomads naked but for a skin carrying clubs and bows They practised crouch burial and covered the grave with a heap of stones surmounted by a goat's horn The latter is a well known custom of the Bushmen Their women blackened their eyebrows which would indicate perhaps a light complexion like that of the Bushmen Some female slaves of this dwarf race have been found in the earliest graves of the true Egyptians Statuettes of the familiar steatopygic type are also found in these tombs

We owe our most accurate knowledge of the early ethnology of Egypt to Elliot Smith who examined the anatomy of the skeletons found in graves of all ages along the Lower Nile The Proto Egyptian (i.e. about 8000 B C) was a man of small stature usually under 5 feet 5 inches He was slender and somewhat effeminate in build The hair was dark and just like that of the Iberian folk of today usually very dark brown and wavy He usually wore a small beard Probably the eyes were brown or nearly black and the skin of a coppery brown colour Over the whole domain from Britain to Somaliland in early Neolithic times there extended this broad belt of Mediterranean or Iberian peoples speaking languages belonging to

the Hamitic group The skull was long (C I 73), and ovoid when viewed from above The nose was small but relatively broad, chin pointed and jaw weak, the face short and narrow

In the fourth millenium B C the Nile Valley was much less habitable than now The delta was small and the elongated river-terraces were largely marsh The peoples north of the First Cataract (Aswan) first learnt to drain the marshes on a large scale, but the wilder southern tribes conquered them (largely owing to the fact, in Elliot Smith's opinion, that they were the first to discover the art of casting copper)

From 4000 B C until about 2800 B C Egypt and Lower Nubia were occupied by one race of the type described above But the southern tribes (who had much Negro admixture) lagged behind in civilization They were akin to the Beja (Bisharin) peoples of today (see Fig 51)

Northward movements into the Lower Nile probably occurred throughout all this period and even earlier The earliest civilization seems to have been largely indigenous, the ivory trade shows that even then they were in touch with the true Negroes much further south Some of the earliest records deal with the peoples of Punt (Somaliland) and show that there has been no marked change in the ethnology of the people for the past five or six thousand years Elliot Smith states that in Egypt this pre dynastic people was probably the nearest approximation to a "pure race" that we know of About 2 per cent were definitely Negroid, and perhaps another 3 or 4 per cent displayed features which suggest the influence of Negroid admixture³

The modern Arabs of Yemen and Hejaz to a large extent conform precisely to the Proto Egyptian type, though certain different types are much more common amongst them than amongst the Early Egyptians But during the Early Dynastic period there entered into Egypt a very definite alien strain of the type called *Armenoid* Thus, before the time of the pyramid builders the peoples of Lower Egypt were being modified At Giza (near Cairo) skeletons much more sturdy than those of the earlier folk were obtained, in which the brain-case is larger, the forehead broader, and the skull wider The jaw is much heavier with a longer, narrow ramus The cephalic index of these alien people was 76.7, while Upper Egypt at this time had the old long headed folk with head index of 73.4 The brain capacity of the Lower Egyptians at Giza was 1,530 c cm, while in the Proto

³Elliot Smith, *The Ancient Egyptians* (London, 1923)

Egyptians it was less than 1400 c cm. The marked aggrandizement of Egyptian achievements at this time must have been due in some measure to the stimulation of this big brained foreign element. There seems little doubt that some of these Armenoids were of Alpine race.

We may now consider the archeology and culture of Egypt. About 10 000 B C these Proto Egyptians used hand made pottery produced fine flint work and used a little copper for pins and chisels. They were bold traders and pushed far north and east. They worshipped Osiris at first but later became sun worshippers. As we have seen they were invaded first from the south and later by the dynastic people. These latter folk are of extreme interest. While the Egyptians were apparently using flints chiefly invaders with somewhat more elaborate weapons were crossing the Red Sea from the east (Fig 54) probably from Elam (south west Persia). These Alpine (or Armenoid) folk brought in writing cylinder seals and started tombs which developed into the pyramids. They first occupied Upper Egypt and started the first dynasty in the delta about 5000 B C. Khufu (Cheops) built the greatest structure of all time and inaugurated the grandest period in the history of Egypt. In Petrie's words. These Alpine peoples conquered by ability not by numbers or mere force. for even in their capital they were not more than one tenth of the men around.

By 4000 B C Egypt was ruled by Syrian kings and a little later western invasions prevailed. But about 3500 B C Southern Galla tribes (akin to the early Proto Egyptians) swept down the Nile and founded the famous XIIIth Dynasty. About 2500 B C the Hyksos or Shepherd Kings from the east again gave a stable if primitive government to all the region from Crete to Bagdad. About 1550 B C the Egyptians reversed the tide and conquered Syria. In the last three thousand years there have been many changes in the rulers of Egypt. Elam Syria and Ethiopia invading the delta just as in earlier times. About 330 B C Greek influence predominated to be conquered in turn by Rome. Neither of these invasions made the same impression as the Arabic conquest in A D 640 which changed the religion and language of the Egyptians and so naturally greatly altered their outlook on life. In 1917 the population included eleven and a half

⁴Based on Finders Petrie's various publications

million Moslems, and about one million Christians, of whom most belong to the ancient Coptic church.

SUMMARY OF FOREIGN INVASIONS OF EGYPT
(The earliest 'historical layers' are at the foot of the table)

<i>Date</i>		<i>Rulers and influences</i>
<i>A D.</i>		
	1875	British control starts
	1801-1875	Egyptian rule
	1801	British eject French
	1517-1798	Chiefly Turkish rule
	1250-1517	Mamelukes (originally Turkish slaves)
	1171-1249	Saladin the Kurd and his race
	1073-1121	Armenian rulers
	969	Fatimid caliphs from Tunis
	641-868	Arabs chiefly governing from Bagdad
	619	Persians
<i>B C</i>		
	51-619	Rome and Byzantium (Greek largely)
	323-30	Ptolemies (Alexander's successors)
	343-332	Persian rule
<i>Date</i>	<i>Dynasty</i>	<i>Rulers and influences</i>
<i>B C</i>		
405-340	28-30	Egyptian rulers under Greek influence
527-405	27	Persian dynasty (Cambyses, Darius, etc)
600	26	Necho conquered east to Euphrates (Greek influence)
1100-600	25-21	Partly Libyan, Ethiopian, and Assyrian kings
1203-1102	20	Rameses attacked by Dorians from Greece
1328-1203	19	Exodus of Jews under Moses at end of 18th dynasty
1587-1328	18	Amenhotep, Tutankahment, etc (used Sardinian mercenaries)
About 2000	15-16	Hyksos, Shepherd Kings from Syria
" 2500	13-14	Partly Libyan kings from the west
" 3000	7-12	Partly Galla kings in the south and Syrian in north
" 3500	4-6	Khufu and pyramid builders
" 4500	1-3	Menes and other legendary kings
About 5000		Armenoid, from Elam or Mesopotamia
" 7000		Nubian invasion, from Upper Nile
" 8000		Proto-Egyptians, from Arabia via Nubia?
		Allies of Bushmen; probably from ASIA
		Palaeolithic Negroes " "

Thus the great interest of Egypt to the student of race movements lies in the innumerable attacks made on this region through ten thousand years by invaders from all sides. These invasions have not

greatly altered the racial constitution for the modern fellahin on the whole are remarkably like the Proto Egyptians of 8000 B C

The salient feature of Egyptian history is surely that it has benefited by a unique series of external stimuli throughout fifty centuries. We have here an assured food supply for hundreds of thousands of fairly industrious and docile fellahin but it is only rarely that the native Egyptian seems to rise to the head of affairs. It seems to the writer that the Egyptian civilization is more largely due to this combination of assured food and central geographical position than to any inherent merits of the Egyptian people as a whole. We shall find later that civilization started many centuries earlier in Persia and adjacent countries. Using modern South Africa as an illustration we find today a civilization which might be described in Flinders Petrie's words quoted above. There also the invader is numerically weak but his brains and initiative are vastly more important than the massed effect of the millions of aboriginal Bantu. Until we know as much of the early history of other countries in the south of Asia as we do of Egypt it does not seem logical to the writer to assume (as does one school of anthropologists) that all the early civilizations originated in Egypt yet we are told that they were carried thence to Mesopotamia, Sumeria, India, Java and even to all the regions of the New World.

Fundamentals of the Present Population

It is the firm belief of the writer of this book that populations today as in the past are distributed almost wholly in response to their environment. With few exceptions if we know the distributions of the crops and mines—which in turn are controlled by climate, soil and geology—we have the key to the human distribution problem. The distribution of African resources appears in Fig. 54 a and Fig. 54 b.

In the left hand map we see that the distribution of the main crops is symmetrical about the Equator. Each crop has its most favourable belt determined by the temperature and rainfall. In the centre is the large area of tropical jungle called the Selva (Fig. 17). This is still being exploited by collectors of wild rubber and wild palm oil. Of course numerous plantations of the same crops are slowly replacing the wild crops. Along the coasts these plantations are more abundant and here we find the bulk of the cacao (cocoa producing) and coconut (copra producing) plantations.

On the drier, slightly cooler borders of the selvas are the regions

where such crops as millets, ground-nuts, and cotton are grown in large quantities by the natives. On the north these merge into the great desert areas—where few crops but dates in the scattered oases are to be found. In the warm temperate and subtropical districts cloves, vanilla, and sisal are grown near the coast; and cotton and coffee somewhat inland. Cotton is a very important crop in the irrigated lands of the middle and lower Nile. Finally, in the temperate lands of both north and south Africa we find the usual crops of wheat, maize, and vines. Olives and esparto grass (for paper) are valued crops in Algeria and Tunis.

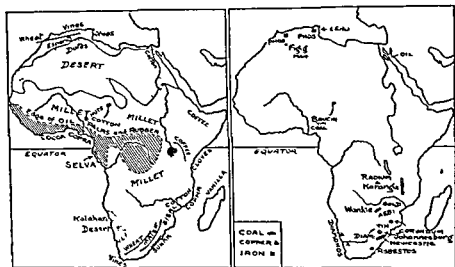


FIGURE 54a.—Crop zones in Africa. Notice their symmetry about the Selva (Jungle) of the Equator.

FIGURE 54b.—Mining Fields of Africa. Except along the north coast they are associated with the extensive Shield. Phosphate and asbestos fields are indicated.

In the right-hand map, Fig. 54 b, the chief mining districts of Africa are charted. Since the continent largely consists of Palaeozoic formations or the ancient rocks of the Shield (Fig. 3) metallic minerals are quite abundant. In the south at Johannesburg is the richest goldfield on earth. Nearby, in peculiar volcanic "necks," are found the main diamond mines. Asbestos and corundum (an abrasive) also occur in the vicinity. In the Belgian Congo are the important copper deposits of Katanga, and radium occurs in this region also. Tin is abundant in the old rocks of Nigeria. Some of the best phosphate

deposits occur in Tunis and Algeria, while manganese (for steels) is found nearby. Coal is not very abundant, but the best fields are found in the south and are charted. Since the continent has not been much affected by late mountain folding, we do not find the 'domes' in which petroleum usually collects. Accordingly there is only one unimportant oilfield near Suez.

CHAPTER XI

THE CHANGING EUROPEAN ENVIRONMENT

A The Build of Europe

It is instructive to compare the build of Europe with that of Australia which has been discussed previously. Australia is isolated and uniform, with a considerable tropical area, Europe is entirely in the temperate belt, and consists of a westward extension of the Asiatic plains merging into the wonderful series of European peninsulas (see Fig 72). By this arrangement an equable marine climate penetrates far into the continent, while the dominant westerly winds are also able to carry rains far over the lands. Yet in both continents we find the usual arrangement of Shield, Downfold, and Young Mountains.

The past history of Europe is controlled by the development of earth waves extending east and west, which have greatly affected the topography during the great earth building periods of geological time. These earth waves have resulted from the compression of weak sediments which were laid down between the Shields. In Devonian times (about 300 million years ago) the floor of the sea between the *North Atlantic Shield* and the *Russian Shield* was strongly squeezed. The consequent folds built up the 'Caledonian Mountains,' shown in the section at the right of Fig 55. As we have seen in other land masses, the ancient mountain zones are gradually worn down to become the plateau blocks of later ages. Thus the ancient plateaux of Scandinavia and the highlands of Scotland are the relics of mountains built up in earlier periods of the geological record.¹

Some 50 million years later a series of swamps, freshwater lakes, and shallow seas formed a long zone from Glasgow to Poland, fringing a continental mass to the south, and perhaps overlying a part of the Russian Shield. Here grew or were deposited great masses of vegetation which ultimately became the great coal belt of Europe. (This controls present day settlement.) Somewhat later, about the dawn of the Permian, a new mountain zone arose from Brittany across to the Crimea (see the Permian section at the right of Fig 55). Relics of this folding occur in the ancient blocks forming the Armorican

¹The times and ages in the geological record are shown along the top of Fig 15. Eocene, Miocene, Pliocene, and Pleistocene are the Tertiary divisions.

Plateau of Brittany the Auvergne region, the Black Forest, the Bohemian Highlands, and the South Russian Uplands of the Ukraine

In Jurassic times (perhaps 80 million years ago) the centre, south and east of Europe was largely a region of warm seas with numerous coral reefs. In early Tertiary times the lands were disposed somewhat like today, save that the old "coal geosyncline" or trough was still beneath the seas—while the Mediterranean was larger than at present and this ancient sea is called *Tethys*

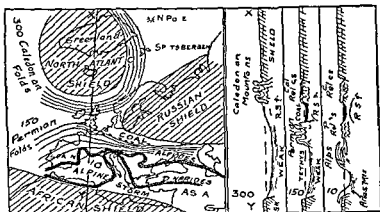


FIGURE 55—The build of Europe determined by the squeezing of weak sediments to make Young Mountains between the three Shields. At the right are given three vertical sections (along the line XY) at the dates specified. Figures represent millions of years ago. R.S. Russian Shield.

In early Tertiary times (perhaps twenty or thirty million years ago) the latest mountain building period of Europe was initiated. This third rampart arose still further south than the Permian buckling, and was accompanied (or perhaps caused) by a downward warping to the south in the Mediterranean region. This period of folding is illustrated in the last of the sections to the right of Fig. 55. A series of mountain arcs was formed and these are indicated in the map in Fig. 55.

Starting from the Central Alps one curved fold runs round the Lombard Plain and continues south as the Apennines to Sicily. Thence it crosses to Africa and is prolonged as the Atlas folds to Gibraltar. To the north of the straits lies the Sierra Nevada, while the Pyrenees Range is a somewhat isolated fold of similar age between the Sierra Nevada and the Alps.

Passing eastward from the Alps is a pair of folds, one passing to the Western Balkans as the Dinaric Alps, the other to Vienna and so across the Danube to the Tatra and Carpathians. This fold curves round the Alfold Basin of Hungary, crosses the Danube again at Orsova, and extends to the Black Sea. It is prolonged to the east by the Crimean Highlands and the magnificent Caucasus, which includes



FIGURE 56—The three main structural types in southern Europe—the Young Fold Mountains enclosing Downfold Basins, and the relics of Permian mountains uplifted again during the Tertiary folding. Note also the Paris Basin. The seven "Gates" are numbered.

the highest mountain in Europe (Elbruz, 18,470 feet). Thus the "Young Mountains" of Europe consist of two more or less parallel folds, known as the *Alpides* and *Dinarides* (Fig. 55). In each case the rocks of the crust have been overfolded away from the *area between the two lines of folding*, as shown in the last section in Fig. 55.

It is interesting to note that some of the most fertile areas of Europe are in the silted basins, such as Lombardy, Hungary, or Wallachia, below the towering peaks of the late earth-folds. Incidentally, we may note that regions like Africa and Australia lack both the fertile basins and the magnificent scenery of these "Young Mountains," though they gain in stability and in the comparative absence of earthquakes and volcanic action.

Somewhat similar downward buckles or basins in the south have

been drowned by the Mediterranean Sea. Thus the Atlas Apennines include the Western Mediterranean Basin. Probably here is the still active source of unrest which has produced the Alpine chain parallel to but further south than the ancient ridges of Permian and Devonian times. Flanking the Mediterranean region are the active volcanoes while an extinct line across Central Europe marks an earlier belt of weakness on the line of folding.

It seems probable that the most striking phenomena of the Alpine folding occurred in upper Miocene times. Grenville Cole gives a graphic picture of the three overfolds which constitute the Swiss and Austrian Alps.

The first moving from the south buckled up and then fell over to the north in the Helvetic region. The second (Lepontine) arose a little to the east and with the same direction and action seems to have flowed onward carrying its limestone front through the gap of Canton Vaud and spreading out in the Helvetic depression like the edge of a falling wave. The third earth wave the East Alpine rising still farther south rose across the Lepontine sheet and flowed northward to the confines of Bavaria. So much occurred within a single epoch and probably in a few thousand years that some of the movements must have been visible to the eye of man had so discerning a creature appeared upon the scene.¹

In the recent book by the writer *Environment and Nation* many examples of environmental control which result from the build and climate of Europe are considered in some detail. In Fig 56 some of the results of the build of Europe are illustrated. The elevated portions of Europe can be divided into the Young Mountains (i.e. Alpides and Dinarides) and the relic blocks which are the worn down roots of earlier fold mountains. Often violent folding in one area is accompanied by an elevation *en masse* of adjacent relic blocks. In Europe Norway the Cevennes (France) and the Meseta (Spain) are such lately elevated relic blocks.

Primitive man made use of the natural corridors across Europe. Perhaps the chief led up the Danube River which has maintained its course in spite of the Alps rising across it. The six main passes across Europe are numbered 1 to 6 in Fig 56. Of these the Bosphorus (1) the Brenner Pass (4) and the Rhone (5) were the chief

¹Grenville Cole *Growth of Europe* (New York 1914) pp 170-3

B. Present Climate of Europe

The salient climatic control in Europe is the presence of a low pressure area near Iceland. This is most intense in winter, and leads to a vast stream of warm moist air entering Europe from the south-west in the winter (Fig. 57). Thus the temperatures in the west are kept remarkably high for the latitude, so that the Lofoten Isles (lat. 68° N.) have the same winter temperature (32° F.) as Greece in latitude 42° N. The remarkable climate of north-west Europe, as

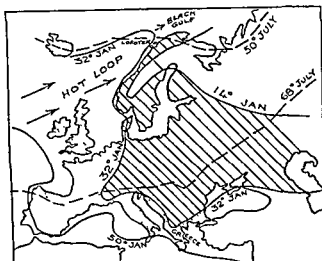


FIGURE 57—Temperature control in Europe. Notice the unusual north-south direction of the January isotherms over Western Europe.

suggested by the north-south trend of the winter isotherms, is discussed further in a study of the various climates of the north temperate area (p. 283). The inland and eastern regions are dry, and indeed only the mountain areas receive much rain owing to their deflecting upward (and thus cooling) the western winds.

In summer the dominant control is perhaps the high pressure to the west of Spain, whereby the most usual winds in Central Europe are north-westerly and northerly. The isotherms lie now more normally east and west than in winter. In the east of Russia is the only portion of Europe with a truly continental climate. The Lower Volga region experiences four months of very low temperature (24.4) in winter. All the remainder has an "insular" climate, i.e., the extremes of climate do not differ greatly from the average conditions.

From our special point of view of changing environment, however, it is important to note that the rainstorms are associated with moving low pressure systems (cyclones) rather than with steady winds. In Europe as elsewhere, these tracks of the "Lows" (as they are usually termed) are fairly well marked, and differ somewhat from season to

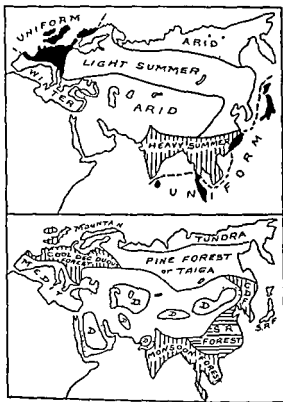


FIGURE 58—Seasonal rainfall and vegetation of Eur Asia somewhat generalized. In the lower figure the dotted areas are steppes *D* is desert *S R F* is summer rain forest. (See pages 200-205)

season. Indeed, as I shall show in a later section these rainstorm tracks have probably varied remarkably during the life of man in the European environment.

As a result of the varying rain controls, we find that Europe can be divided into four regions. In the north west is an area receiving

fair and almost uniform rains through the four seasons (Fig 58). Through most of the north and centre the rainfall is chiefly in summer. On the Mediterranean coasts the rain is typically in winter, while only in the far east and north east (and in Spain) is there any real shortage of rain thus constituting some restricted arid regions.

C *Vegetation of Europe*

The natural vegetation may be considered briefly under six headings, following Hardy's classification³. Of little significance to man, whether prehistoric or modern, is the *tundra* flora which fringes the Arctic Ocean. Nor is the special *mountain* vegetation of Norway of importance. A great belt of *coniferous* forest (*Taiga*) extends across Europe north of latitude 60°, where the short summer and the five months of frost prevent the growth of broad leaf forests. Even today the population is very sparse in these pine forests, and the region has never been important in man's history (Fig 58).

The remaining three zones of vegetation are of great human interest. In the arid east is a wedge of *steppe lands* projecting from the gigantic steppes of Asia into the heart of Europe, almost to South Poland. This has been the path of entry of almost all the Asiatic peoples of Neolithic times and later. These grass lands are determined, of course, by the markedly seasonal rainfall, which all falls in summer. The grass grows rapidly in the spring and early summer, and is parched during the succeeding dry months. Here, however, is a vast area of rich black soil (*chernoziom*) which is now being converted into wheat, maize and beet fields. A similar steppe is found in the sheltered fold basin of Hungary, while south east Spain is so dry that analogous conditions prevail.

This wedge of steppe lands is approximately driven between a broad belt of *deciduous forest* in north west Europe, and a narrow belt of *Mediterranean flora* to the south west. The latter was naturally the easier type of country for early man to traverse. With the wet winter and hot, dry summer, forests do not develop on any large scale. The trees are usually low, thorny, and evergreen. Creepers are rare, but shrubs and bulbs are abundant. The chief forests consist of patches of live-oak and pines, but planes and deciduous oaks are often found. Great injury has been done in these countries by the ruthless

³Hardy *Geography of Plants* (Oxford 1920)

clearing of these slow-growing forests. The soil is thus washed off the hills, the streams are either flooded or silted up, and the whole country side laid waste.

The leading states of Europe are found in that region which was once heavily forested with *deciduous trees* with broad leaves. But the "interference of man, mostly by cutting or burning forests, for smelting, agriculture, or cattle and sheep raising has entirely altered the original covering"⁴ The oak and beech are dominant trees, with chestnut, birch, and ash next in importance. Beech forests exclude all underwood, but other types are more open. In early European history traffic through this forest belt was largely confined to the large rivers, but heather moors occupy large portions of poor soil and peat bogs develop in poorly drained localities.

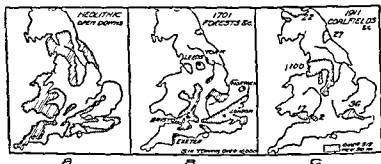


FIGURE 59—A Open country suitable for folk without metal tools (Fleure and James) B Dense populations with handicrafts. Six towns over 10 000 C Dense population on coalfields. The number of towns over 10 000 noted. (After Muir)

In Britain vast forests once covered large portions of the land. The beech woods and oaks occupied the lowlands, while pines clothed the higher slopes from 700 feet up to 2 000. Fleure and James⁵ give an interesting account of the way in which Neolithic man in Britain was confined to the drier open country. Wolves and wild boars occupied the forests, and ague infested the swamp lands. He settled chiefly in the uplands, especially in those of Wales and in the limestone downs. The chalk was useful for earthworks, and contained the flints used for his tools. Springs and pastures were abundant on these downs. Kent, Hampshire, the Mendips, Devon, the Cotswolds, and

⁴Hardy *op cit*

⁵In the *Journal of the Anthropological Institute* London 1916

Western Wales were probably the most closely settled portions of Britain in these times (see Fig. 59 at A).

The Thames Valley and the Midlands must have been very inhospitable to folk without metal tools to cope with the forests. The remarkable migrations of population in England, from the downs, thence to the forested and agricultural lands, in the Middle Ages and up to 1700, and later to the coalfields, are illustrated in the three small maps given in Fig 59

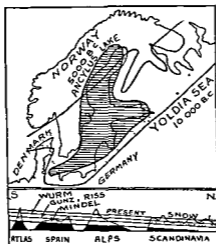


FIGURE 60—Changes in the topography of the Baltic Sea during the last 10,000 years. Below, a section (across Europe) shows the heights of the snow-line during the four Ice Ages and at present.

D. Prehistoric Changes in Environment

The significant features of the Great Ice Ages are indicated in the section at the foot of Fig. 60. Here is a cross-section across Europe from the Atlas Mountains to North Cape. At present the snow-line lies about the levels indicated, sloping down, of course, toward the North Pole. Most of the Pyrenees is below the snow-line. However, in the four major cold periods of the Pleistocene (i.e., the four Ice Ages, Gunz, Mindel, Riss, and Wurm), the snow-line descended to the levels indicated in the section. It is not quite clear yet if the Mindel Ice Age was the coldest.

In another section (p. 158) I give a résumé of the well-known changes in the European environment during the Great Ice Ages. The later changes have been clearly discussed by C. E. P. Brooks in

the *Quarterly Journal of the Meteorological Society* for July, 1921 In this paper he gives a novel correlation of the changing environment with the changing position of the storm tracks during the last 30 000 years in Europe

The last (Wurm) Ice Age was of much less extent than the two preceding ones Valley glaciers occurred in North Ireland and North Scotland while the Scandinavian Ice Sheet reached to Central Germany and just covered Denmark A strong Anticyclone (or High) would lie over the ice sheet, giving powerful east winds over Germany and Holland As a result ancient 'horse shoe' dunes (with the front to the east) were built up in these latitudes and still exist

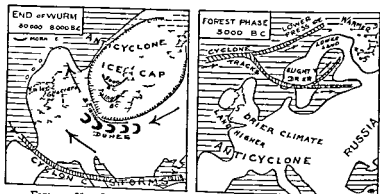


FIGURE 61—Climatic changes in north west Europe (Based on C E P Brooks) The storm belt (wet) is far south of Britain in the Ice Age but to the north in the Forest Phase

Brooks gives a climatological map of Europe for this period, which he dates from 30 000 to 18 000 B C The cultural stage was the Magdalenian period the latest stage in France when Palaeolithic men dwelt in caves Reindeer were abundant According to Brogger, the climate of southern Norway, where the ice met the sea, resembled the present climate of northern Greenland or Spitsbergen, with a mean annual temperature of about 17° F (see Fig 61 at left)

On the retreat of the ice, its edge seems to have remained over the Baltic for some 8 000 years About 10 000 B C it lay along the southern coast of Sweden and during the next 2 000 years it withdrew to about 59° N The moraines deposited at the front of the ice-cap during these resting stages are shown in Fig 61 About 8000 B C a great moraine was piled up about the latitude of Stockholm Then

came another period of very rapid retreat, occupying nearly 3,000 years, followed by a further halt near Ragunda about 5000 B. C. After this the ice-sheet split into two portions and the glacial period is regarded as over.

Brooks gave the following table summarizing the changes deduced from geological and biological evidence, chiefly in north-west Europe.

<i>Phase</i>	<i>Climate</i>	<i>Date</i> B. C.
1 Last Wurm Glaciation	Arctic	30,000-18,000
2 Retreat of glaciers	Severe continental	18,000-6000
3 Continental	Continental	6000-4000
4 Maritime	Warm and moist	4000-3000
5 Later Forest	Warm and dry	3000-1800
6 Peat-Bog	Cooler and moister	1800 B. C.-300 A. D.
7 Recent	Becoming drier	A. D. 300 on

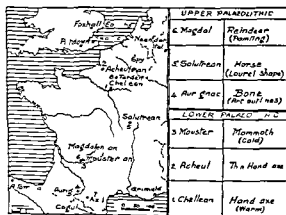
In the Continental Phase the Baltic became a closed freshwater lake, which is shown as Ancylus Lake in Fig. 60. At this time the south-west Baltic lands stood 400 feet higher than at present. Later, however, the climate became relatively dry, and warm conditions supervened in Scandinavia, which had a rich forest flora. A rapid movement of submergence then set in, and the Littorina Sea developed in the Baltic area. These marine conditions raised the temperature 3° F. above its present level in Sweden. The cyclonic storms with their heavy rains now moved along the Baltic track. The present small ice-fields of Norway for a time practically vanished. This occurred about the middle Neolithic period in north-west Europe.

By 3000 B. C., or towards the close of the Neolithic period, England and Ireland were elevated considerably, and part of the North Sea was land. This gave much drier conditions to Britain; and probably the Gulf Stream change also tended in the same direction. The cyclone track migrated north, and the bogs in Ireland, Scotland, and Germany became dry enough to support *forests*; while in Russia steppe conditions obtained (see Fig. 61 at right).

The Irish bogs dried so completely that they were extensively inhabited. In Donegal a two-story log-house of this period has been excavated, and since its building 26 feet of bog has been deposited above its floors. This dry period apparently corresponds to the legendary Heroic Age of Ireland (about 2000 B. C.), when the vigour of the Irish reached a level never since attained.

This dry phase was followed by the *Peat bog Phase* as the present distribution of land and sea was reached. Probably all lands in these latitudes were somewhat wetter than in the phase just before or since. In the years since A D 300 bogs in parts of Ireland, Belgium, and North Germany have ceased to grow, showing that conditions are now becoming drier again. Scandinavia is rising and the Norwegian glaciers are slightly increasing in size.

No one now denies the tremendous climatic changes which we call the Great Ice Ages. They finished about 30,000 years ago. But it is to be remembered that there have been noteworthy "swings" in climate during the last 6,000 years. Every year the accumulated data (especially those indicating marked changes in the forest-covering in the past) make these climatic changes more and more certain. One may be sure that they were potent factors in determining past human migrations even as the short period changes of today (such as ten unusually dry years) set in movement large numbers of farmers, for instance, in Alberta or Dakota.



CHAPTER VII

RACES IN PREHISTORIC EUROPE AND EARLY MIGRATIONS

A Time and Distribution

The great importance of Europe in our study of race-migrations lies in the fact that in this corner of the Old World the sequence of the ethnological "strata" has been correlated with that of the latest geological strata. We are thus able to tell how the climates and lands varied in character while the first primitive tribes were peopling Europe. Since it seems probable that similar migrations were occurring all round the heart of the Old World, we can get an approximate idea of the history of these migrations in regions remote from Europe.

This is not the place to enter into the vexed question of the actual length in years of the later geological ages. We may assume that 30,000,000 years have elapsed since the beginning of Tertiary times. The end of Pliocene time and the dawn of the four Great Ice Ages are variously set down as from 100,000 to 840,000 years ago. Since the estimates by later investigators usually indicate longer and longer periods, we may take it that the Pleistocene (Ice Ages) period lasted about 800,000 years.

The period since the last Ice Age—usually called Recent or Quaternary—is set down at about 40,000 years. Estimates differ with locality, for the Norwegian Highlands, Iceland, and Greenland still contain large ice-caps dating from the Ice Age period.

The table on page 158 (arranged approximately to scale, and so apparently cramping Quaternary time) shows the salient features. It is based in part on that given in Osborn's *Men of the Old Stone Age*. It is to be noted that the table is based on data collected in the deposits of Western Europe, i. e., on the outer margin of the Eurasian continent. We may assume that man evolved in far distant lands—most of the evidence points to Central Asia—and that many long years elapsed before he reached Western Europe *after he had evolved elsewhere*.

It is only in later records that we can see clear examples indicating the duration of this *period of migration* from Asia to Europe. The table on page 159 perhaps makes the matter clearer.

PLISTOCENE AND RECENT HISTORY

Years ago approximate	Ice Age approximate	Descents of snow line in Alps	Stone culture	Human races in Europe	Flora etc Western Europe
Quaternary		Warmer than now	Neolithic	Alpine	
40 000	WURM	1 200 metres lower	Upper Palaeolithic	Cro-magnon	
100 000	Third interglacial	Warmer than now	Lower Palaeolithic	Neanderthal	Reindeer
200 000	Riss	1 400 metres lower	Acheulean	Neanderthal	Steppe fauna
300 000	Second interglacial	Warmer	Chellean	Pitoldown?	Cold tundra
400 000	MINDEL	1 500 metres lower	Chellean?	Heidelberg?	Elephas antiquus
500 000	First interglacial	Warmer	Chellean?		Elephas Meridionalis
600 000	GUNZ	1 200 metres lower		Pithecanthropus (Java)	Warm forest
700 000					
800 000		Warmer than now	Eoliths		
			Eoliths	Ape-man?	

Pleistocene during five million years?
Miocene

APPROXIMATE TABLE ILLUSTRATING DIFFERING CHRONOLOGY
IN ASIA AND EUROPE

<i>Year</i>	<i>Environment Western Europe</i>	<i>Western Europe Culture</i>	<i>Eastern Europe and Egypt</i>	<i>Mesopotamia and Turkestan</i>
B C 0 55		IRON (Danes) Caesar		539 Cyrus
			1100 Homer (IRON) 1350 Tutankha men 1800 Abraham	1300 Moses 1400 IRON (Halys R)
2000	Daun Age	BRONZE COPPER	BRONZE Crete	2750 Sargon
4000	Littorina Sea Gschnitz Age Ancyclus Lake	.	COPPER Menes	BRONZE 5500 Nippur and Eridu
6000				COPPER
8000				Sumeria
10 000	Yoldia Sea	Neolithic Tardenois		
12 000	Buhl Age			
14 000	Fennoscandian Moraine	Magdalenian	Neolithic	Susa?
16 000	. .	Magdalenian		
18 000	Achen Age?	Aurignacian	Upper Palaeo- lithic	Neolithic
20 000	Gothicglacial Moraines	Capsian		Upper Palaeo- lithic
50 000	Wurm Ice	Mousterian		

From this table we see that the Neolithic period started about 17,000 B C in Mesopotamia, but about 10 000 B C in Western Europe. So also the Bronze period began about 5500 B C in the East, but only about 1700 B C in Middle Europe.

A very interesting table (due chiefly to Montelius) illustrates the same point in greater detail¹

MOVEMENT OF METAL AGES ACROSS EUROPE

Culture	Scania	Mid Europe	Hungary	Greece	Egypt	Turke stan
	B C	B C	B C	B C	B C	B C.
Iron	?	800	?	1200	2500?	?
Bronze	1900	2000	2000	2500	3000	4000
Copper	2500	2500	3000	3000	5000	6000

Hence the migration period for the Neolithic culture across Europe from east to west (see earlier table) was about 6,000 years, for copper about 2 500 years and for bronze 2 000 years

These culture movements took place when Europe was fairly well populated as compared with earlier ages. We may, therefore, postulate very great lapses of time for the spread of earlier cultures, such as those characterizing the Palaeolithic peoples

It is increasingly difficult to synchronize events as we move back to Palaeolithic times. Yet Pumpelly² dates the *founding of cities* in Persia and Turkestan before 10 000 B C, at which time some authorities place the Magdalenian (Palaeolithic) culture in Western Europe. The above tables certainly indicate that true civilization spread to Egypt from Sumeria and Turkestan. If this be true the Alpine peoples were probably the first founders of a real civilization. It is worth considering the fact that Central Asia was a region of great stimulus during late Tertiary time. This produced rapid evolution of mammalian life as everyone knows. It is not usually realized that, *a priori*, it would produce rapid *cultural* progress also at any rate until the onset of desert conditions retarded progress in the Central Asiatic region

B Early Races in Europe

The first race discovered in Europe (unfortunately only represented by a single lower jaw) is the Heidelberg type, which may date back to the Second Interglacial Age³. It may be described as a primitive, more powerful and ape like ancestral form of Neanderthal man⁴

¹See Tyler *New Stone Age* (New York 1921) table on p 177

²See R. Pumpelly *Explorations in Turkestan* (Carnegie Institution 1908)

³Sollas *Ancient Hunters* (New York 1924) chapter xii

⁴H F Osborn *Men of the Old Stone Age* (New York 1915) p 100

The next type is that found in Piltdown in Sussex, associated with very early flints of the pre Chellean type. It represents a different type from Neanderthal man *with its rugged brow*, for it has a smooth forehead. The skull is broader, but very thick. The jaw, however, is ape like. It has been suggested by some ethnologists that this type evolved into modern man, while the more recent Neanderthal man in the marginal lands of Western Europe became nearly extinct. The links between the many varieties of Neanderthal man and the Negroids are as close as can be expected. As we have seen (p 131) many scientists, including the writer, believe that Neanderthal man represents an early stage in the development of modern man.

During the latter part of the Third Interglacial, Europe was inhabited by Neanderthal man, whose remains have been found over wide areas of Central and Western Europe. He was no doubt driven somewhat south on the advance of the Wurm Ice Sheet, but he seems to have spread north again after this period right through the epoch characterized by Mousterian cultures. Thus relics of this race have been found in Spain (Gibraltar), in the Dordogne of France (La Quina, Le Moustier, La Chapelle), in Belgium (Spy, La Naulette), in Croatia (Krapina), in Bohemia, and in Germany. Also artefacts of this race have been found in Britain (Kent's Hole and Crayford), and especially in the type district of Le Moustier on the Vezere River (in the Dordogne) some 100 miles east of Bordeaux. (See the map on p 156.)

Thus from 125,000 B.C. perhaps to 25,000 B.C. Europe was occupied by these folk. They had large narrow heads (cephalic index 73) with over-hanging brows and retreating foreheads. (The lateral prominences on the eyebrows are found today in some Australian aborigines.) They had very wide, ape like noses and long upper lips. The chin receded strongly, the jaw was prognathic, and the teeth very strongly developed. The skull cap was flattened (platycephalic) and narrow or extremely dolichocephalic. The face was long, while the nose bridge receded more than in any race except the Australians. There is little doubt that the Australians are nearer to the old Neanderthal folk than are any other peoples. Indeed, some writers, such as Dixon, boldly label these relics as representatives of an Australoid "layer" in Europe. At Brun in Moravia, twelve skeletons of Palaeolithic age have been found which are almost indistinguishable from Australian aboriginals. Dixon mentions Australoids from Beira, Teruel, Sardinia, and Calabria. One could hardly expect exact agreement between ancient Neanderthals and living Australoids, when

they are separated by such intervals of space and time. Hence the writer does not agree with those who see no meaning in the large number of these similarities in anatomy especially when it is supported by the evidence of the migration zones and strata.

The geographical factors point to a widespread Australoid stratum throughout Southern Asia and this seems to march with the Neanderthal stratum in Europe in a fashion which strongly supports the view that they are variants of the same primitive type. As we have seen the Broken Hill skull from Northern Rhodesia is admitted to link the African Negro with Neanderthal man while the Wadjak skulls of Java are relics of very ancient Australoids there. (See the discussion on p. 133.)

It seems almost certain that true Negroids entered Europe either before or with the next invasion that of the Cro-magnon folk. The Grimaldi skeletons (found near Monte Carlo) bear many resemblances to the Negroids i.e. in their cephalic index (69) their jaws chin nose teeth and cheekbones. Yet amid the ninety skeletal relics of the Cro-magnon folk only two Negroid folk are known. Sollas is of the opinion that they indicate a stratum of Negritoes akin to the Bushmen who lived in Western Europe during the dawn of Aurignacian times. The evidence is mainly based on the small statues and rock paintings (found in Spain and France chiefly) which certainly point to a race akin to the Bushmen. At Willendorf (near Vienna) a statuette of a nude woman is steatopygic and has hair apparently of the pepper-corn type. Similar Negritoid figures come from Brassempouy and Lespugues in the south of France and perhaps indicate a former widespread Negrito stratum.

C *Cro-magnon Man*

With the decline of the Neanderthal people we find an extensive invasion by the Cro-magnon people who arrived in upper Palaeolithic times after the last great glaciation. They entered Western Europe probably about 20,000 or 30,000 years ago. They exhibit no Negroid characters but seem to have reached Europe from Asia along the shores of the Mediterranean probably chiefly *via* North Africa but also perhaps *via* Italy. They followed in fact the same corridor as did the Arabic invasion much later in the seventh century A.D.

The chief characteristics of the Cro-magnon type are as follows. They were mostly of high stature especially the first comers ranging from 5 feet 10 inches to 6 feet 4 inches. A shorter type however

occurs at Chancelade (Dordogne) which was only 4 feet, 11 inches high. The skull contained an unusually large brain, though the head index was very low (71). The forehead is very broad, which is most unusual in connexion with a narrow skull and the head is therefore *disharmonic*. The nose is narrow and the upper face vertical, as in modern high types of men.

This wonderful race is characterized also by great artistic ability. 'More than 20 000 years ago there sprang up an art never since surpassed in its own field except perhaps by the Greeks.' So writes Osborn, and the following table based on his work epitomizes the growth of Art. (See the map on p. 156)

EVOLUTION OF ART

B. C.	Western Europe environment		Age	Incised figures	Sculpture	Painting
15 000	Forest		Azilian	None	None	Coloured pebbles
20 000	Steppe	Magd	Upper	None	None?	Conventional
			Mid	Fine ivory	Slender figurines	Polychrome
25 000			Lower	Deep outlines	High relief	Bisons
30 000				Engravings		Flat tint
30 000			Solutrian		Bone sculpture	?
30 000			Aurignacian	Stiff profiles	Heavy human	Linear tracings

The Cro-magnon people reached their highest development in Magdalenian times. Their homes extended from the River Ebro through France and Germany to Poland, but this highest type does not seem to have spread along the Northern Mediterranean coasts. As the forests extended northward and as the reindeer retreated to the north after the last Ice Age, this race dispersed into many colonies. It was also displaced by new races coming from Asia. Yet representatives of the Cro-magnon folk still remain in the Dordogne, where the same disharmonic proportions are found in the Frenchman of today. The cephalic indexes of many of the living range from 72 to 75 (which is equivalent to 70-3 on the Cro-magnon skulls). There is naturally no entire modern district in France with an average less

than 76 This type is very abundant also at Oleron and Lannion in Brittany, and in the hills of Thuringia It was prevalent among the extinct Guanches of the Canary Isles and is still very common among the living Berbers of North Africa

Sollas⁶ has put forward weighty arguments in support of the theory that the modern Eskimo and associated Algonkians have an ethnic connexion with the Cro magnons of Western Europe I shall hope in a later section to show that they all belong to the same migration zone, which seems to me strongly to support the theory of Sollas He instances the similarity in the arrow straighteners hair pins, pendants snow scrapers line-engravings etc He would associate the Eskimo with the short Chancelade type, and the Algonkians with the taller more common type

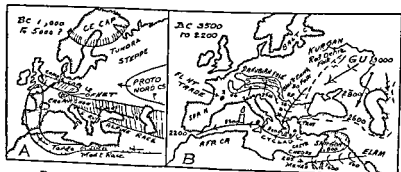


FIGURE 62—Migrations in Europe during Neolithic times. A the entry of the three modern races. B later movements of Alpine and early Nordic (Gu) peoples

D Entry of Modern Races

In early Neolithic times we reach a period when the major races of Europe entered that continent (Fig 62) There seems little doubt that these new comers (who form the major stratum in Southern Europe) made use of the ancient corridor along the Mediterranean shores They are perhaps most typically represented in their primitive state by the Somali and Galla peoples in Ethiopia today, and we may picture similar folk moving throughout most of the lowlands of Europe in early Neolithic times They constitute the *Mediterranean* race which is found still in the majority in Southern Italy Southern Greece Corsica, Sardinia, Western Spain Portugal Wales

⁶Sollas *op cit*

Devon (?), Ireland, and Western Scotland Peoples akin to these were almost wholly responsible for the megalithic monuments, and by these and other evidences can be traced through Asia, the East Indies, and America

As the conditions improved in Central Europe, the northern routes *via* the Black Sea and the Danube, and *via* the Russian steppes came into use The first broad headed people (C I 86) arriving in Europe probably moved along the Danube, thus traversing the great forests Their skulls have been found at Ofnet (East Bavaria) and these probably slightly antedate Neolithic times (Fig 62) They also occur at Furfooz (near Dinant) and Grenelle (Paris) These were the advance guard of the great Alpine waves from Central Asia

Of equal interest are the folk who arrived during this transition period (at the dawn of the Neolithic Age) in the Baltic region They were ignorant of agriculture and pottery They had a bone and horn culture, which was ornamented with crude animal drawings These are very unlike the earlier Magdalenian art, but resemble those found in the Ural and Altai regions Their artefacts have been recovered in great numbers from the marshes of Maglemose (of West Zealand) in Denmark They have been reasonably classified as the first Nordic folk to enter Europe One school of ethnologists, however, thinks that the Nordic peoples are a mixture of Mediterraneans and later Asiatic peoples, while another believes that they are merely "bleached" Mediterranean peoples We may here also refer briefly to the Ainu (of North Japan) as primitive members of the same migration zone, characterized by the same abundance of hair and the same cephalic index as the Nordics

The present writer's explanation of the similarities between the Nordics and Mediterraneans has been given on page 53 It is worth noting that blood tests show a strong resemblance between these two groups, as indicated in Fig 63 The marginal people in Europe have high blood indices, the central Alpine peoples have low indices It is important to note that these low indices are typical throughout Central and Eastern Asia, which certainly supports the writer's deduction (on other grounds) that the European Alpines and the so called "Mongolians" are closely akin

We must realize that much of the ancient population of East Europe was long headed and closely allied to these so called Nordics Thus in Russia in the kurgans (or tumuli) of the Stone Age, three-quarters of the skulls were narrow In the eleventh century about

half the people were of this type, while today the population is Alpine and only contains 10 per cent of the narrow heads. Similar changes have occurred in Lombardy and Swabia.*

We have now to discuss briefly the arrival of the main bulk of the broad-headed Alpines and then that of the allied Slav peoples. The chief feature of the distribution of the European Alpines has given them their name. They constitute a wedge which extends across the Alpine regions of Europe separating the northern 'Nordics' from the Southern Mediterranean people. They occupy the rugged



FIGURE 63—Blood tests of European peoples slightly simplified from Hirsfeld and Steffan. Indices under 2 correspond to the Alpine race and extend east to the Pacific. Indices over 3 correspond to the Nordic and Mediterranean races. (*Rassen Physiologie* Munich 1928.)

mountainous and unattractive areas to a very large extent. This is usually a sign of primitive occupation. It is however, not to be supposed that these Alpine folk advanced by the difficult mountain passes scrambling from crag to crag like a chamois! Their early migrations moved west along the Danubian corridor at a time when Northern Europe was a bleak unattractive tundra.

In concluding this brief review, I would emphasize the fact that no explanation of European race-origins can be successful which is not based on maps which show how the racial zones of Europe link up with those in Asia. This aspect has been somewhat ignored in the

*See A. Mosso *Dawn of Mediterranean Civilisation* (Baker 1911) p. 408.

past, and, in part, seems to have led to the narrow-headed folk of Western Europe occupying too large a proportion of space in that portion of ethnological literature which deals with race-classification

E Early Alpine Migrations

We have very little knowledge of the early migrations of the brackish Alpines into Europe. No doubt they moved westward more or less continuously during late Palaeolithic times, and, indeed, they are still expanding their boundaries all round the Eur-Asian continent. If the writer were asked to epitomize World History, it could be done in the following five words: *Expansions of the Alpine Race* (p. 270).

As regards Central Europe, some of the main migrations from B.C. 3500 to B.C. 2200 are indicated in Fig. 62B, which is based largely on data from Peake and Fleure.⁷ Four slow waves of movement, all of Alpine peoples, moved from east to west in this millennium. From Persia moved the "Falcon Folk," who may have constituted the ruling classes in Egypt after the time of Menes. Other brackish tribes, known as the "Black Earth" people, were being driven from the Ukraine into Greece in the period between B.C. 3000 and B.C. 2600. Somewhat later, primitive peasants slowly occupied the Danube Valley, reaching its headwaters about B.C. 2300. Towards the end of this period, we know of trading voyages made by folk whose headquarters were in the Cycladic Islands of the Aegean Sea.

F Early Southern European Migrations

Owing to the discoveries of Sir Arthur Evans and others in Crete, evidence is accumulating about racial migrations in early times in Southern Europe. Very soon after the beginning of the Minoan period the Alpine brackish were beginning to enter Crete. In the regions bordering on the northern Aegean there seems to have been a series of migrations, one soon after 2000 B.C., one about 1450, or a little before, and another one about 400 years later. There is reason to believe that these movements may be associated with other ethnic movements in the Western Mediterranean, which may have been due to the migration westwards of tribes who were dispossessed in the east.

About this time we may imagine all South and West Europe sparsely settled by Mediterranean races speaking Hamitic languages probably akin to Berber. In the far north it seems likely that there

⁷H. Peake and H. J. Fleure, *Corridors of Time* (Yale University Press, 1927).

was a widespread group of Finnish people, who came in from Asia and had settled in the lands from Perm across to Sweden. They also spoke a non Aryan language, but it is not clear what were their relations with the narrow headed folk whose remains occupy the Kurgans of Russia.

Probably during Neolithic times, about the twentieth century, B.C., there entered the first groups of the great Aryan speaking migrations. The relation of the Aryan speakers to the Alpine or Nordic races is still little understood. It is discussed briefly on page 190. The Aryan speakers almost certainly came into Europe from Turkestan and the Pamirs, while the other great linguistic group, the Altaic speakers such as the Finns, came from the Altai region to the north. There may have been small migrations at first possibly of very broad headed people akin to the Cevenoles of France or to the Albanians. But the numerous tribes constituting the main body of the Keltae followed on about 1500 B.C., probably preceding the Teuton-speakers who may have largely constituted the Nordic migrations.

G *Early Historic Migrations in Europe*

About 500 B.C. we find that the Teuton tribes were settled primarily in South Sweden, Denmark, and the Baltic coasts. The Keltae were chiefly in the French lands, and had already perhaps sent over one migration to Britain. Some authorities believe that this first or Gaelic migration was derived from the western Keltae, while the second migration (of the third century) spoke Brythonic (i.e., British or Welsh), and was composed of Belgae from the eastern domains of the Keltae. Both of these migrations consisted of somewhat broad headed people, who conquered the Iberians (Silures) in Britain. They imposed their languages on them, and then apparently largely merged into the bulk of Iberian narrow heads. At any rate the Keltic language is now spoken by no broad headed people except in the peninsula of Brittany. But it has replaced what may have been ancient Hamitic languages in Ireland, Scotland, and Wales.

No doubt by this time the basin of the Vistula was occupied by the early Slavs. The westernmost tribes were known as the Wends (Veneti) and spread right into modern Prussia, where a small group still remain near Berlin. About 400 B.C. Rome was just rising into prominence, largely as the result of a merging of Northern Alpine peoples with the old Iberian folk of the Etruscan and Mykenan civilization.

For the next 2,000 years the European peoples swayed back and forth as the result of invasions of territory largely on the eastern side. The change of environment which brought this about is discussed in the later chapters on Asia. Thus, about 600 B C the Keltae moved south west into Spain merging with the aboriginal Iberians to form the Keltiberian tribes. Many types, including the Bituriges (cf *Berry* in France), later occupied Northern Italy. About 250 B C some allied tribes marched into the Balkans and reached as far as Asia Minor, where they founded "Galatia" (possibly a form of "Keltae")



FIGURE 64A—Layer-diagrams showing Barbarian migrations from A D 100 to A D 450. None of them altered national stocks largely.
 B—Barbarian migrations from A D 450 to A D 1000. All except Ostrogoth, Lombard and Varangian modified national stocks.

The colonies of Carthage (largely Iberian) yielded to Rome about 200 B C, and for some 500 years Rome carried her civilization, her laws, and her language into all the Romance regions of Europe. It must not be forgotten, however, that the Latin tongue is fairly close to the Gaelic, for they both belong to the "K" group of Aryan languages (see p 187 *postea*). Hence, the change in speech was not very marked in the case of the Western Kelts of Spain and France.

The most significant period of migration in Europe is called the Folk-Wandering*. It started about the time of Christ, when the blond Nordic tribes called the *Goths* left South Sweden (perhaps owing to long continued wet seasons) and marched south into Germany (Fig 64A). In the course of the next two centuries they ravaged South East Europe, but ultimately settled in or near Wallachia.

Somewhat later the first of the modern Asiatic invasions occurred

*On this topic see the author's *Environment and Nation* (Toronto, 1936), chapter IX.

The Hun migration is believed by Dr Wislocki to have originated far away in North China. About A D 84 a group of Hun peoples was driven west to the Aral region and they fought with and incorporated many peoples allied to the Finns near the Caspian Sea. About A D 372 they crossed the Volga (Fig 64A) and under Attila they marched through Europe to be flung back near Troyes (France) in A D 451. No doubt many typical Mongol people (see p 209) took part in this invasion but all sorts of Western Asiatic tribes were incorporated in the Hun hordes including many Slav and Finnish peoples. These Hun invasions naturally displaced the Goths whose migrations into the Balkans and thence into Italy and Spain are sketched in Fig 64A. Meanwhile the Vandals had preceded them into Italy and Spain and were now driven into North Africa (A D 429).

The second phase of the Folk Wandering followed the downfall of the West Roman Empire. The migrations of the Franks Anglo Saxons Ostrogoths and Lombards are shown in Fig 64B. In the sixth and seventh centuries the Slavs moved in large numbers from the north west into the Balkans meeting there many Bulgars who had come from the Russian steppes. From 450 to 900 there were repeated migrations from Scandinavian countries which led to great changes in the racial composition of France and Britain.

The third phase (consisting of Asiatic invasions) was ushered in with the invasion of Spain in 711 by Arabs and Moors (of Asiatic culture). Magyars speaking Altaic (akin to Finn) invaded Hungary in 896 and founded a new nation. Mongols in 1222 and 1237 conquered most of Russia and were not driven back for several centuries. Finally the Turkish invasions of Europe lasted from 1355 until the present century.

With the discovery of America was inaugurated a series of migrations of a very different type and we may close this chapter by a brief reference to the little known migrations of the Russians into Siberia. These took place during the same time that the English were trying to settle North America and are perhaps the most significant migrations of people which have occurred in Asia in historic times. In Fig 65 is shown (in the inset) the area occupied by the peoples of Slav culture in A D 500. It barely includes the basin of the Vistula. By 1584 the Russians controlled most of European Russia though the prairies were not adequately settled till about 1800. In 1580 Cos sacks under Yermak invaded Siberia. Tobolsk was founded in 1590 many years before Virginia was permanently settled but long after

the Spanish and Portuguese had built towns in America. Yakutsk followed in 1637, and by 1639 the Russians had reached the Pacific. In 1648 Deshnev sailed through Bering Straits

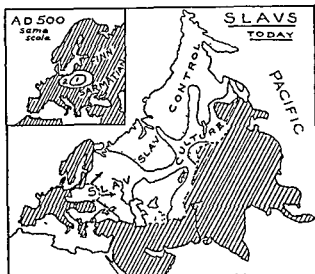


FIGURE 65—The most striking cultural change in the Old World—the expansion of the Slavs (Partly after Bowman)

Now turn to the larger map in Fig 65 and note the enormous area which is controlled by the U S S R. The more attractive regions (shown white) are already sparsely settled by Russians. It is important to remember that Siberia never contained many aboriginal people. Today there are about 27 million Russians and about ten million non-Russians living in harmony in associated republics in Siberia (including Turkestan and the Southern Urals).⁹

⁹Bruce Hopper, "Limits of Land Settlement" (*10th International Studies Conference, Paris, 1937*)

CHAPTER XIII

THE RACES OF FRANCE AND BRITAIN

A Cultural Groups in France

Let us consider in some detail the constitution of the races inhabiting the region between the Pyrenees and the Scottish Highlands. This includes most of those peoples who have been in touch with Britain during historic times (see Fig. 66).

At the western end of the Pyrenees we find a most interesting people, the Basques. They are linked together by a community of interest which is based upon a most remarkable language. Basque is utterly unlike any other language in Europe, and is usually accepted as representing the tongues spoken by the folk in Europe before the

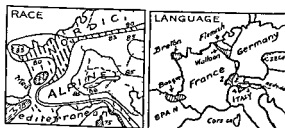


FIGURE 66—Comparison of racial divisions (left) with national and linguistic divisions (right) in Central Europe. Swiss languages are French (1), German (2), Romansch (3), Italian (4). Numbers are head indices.

great invasion by the speakers of Aryan languages. Quoting Ripley, we may note that Basque is characterized by "terrific complexity." Thus the verb habitually includes all pronouns, adverbs, etc. "*Aspicuelagaraycosaroyarenberecolarra*" is one complex word, signifying "The lower field of the high hill of *Aspicuella*." This merging of ideas into one word is quite characteristic of other early languages, notably among the Amerinds of north-east America, and of the Abkassians in the Caucasus. Judging from their marginal position, the original Basque speakers preceded the Aryan linguistic waves, of which Gaelic was the first. We have some data indicating that the Gaelic wave reached France near the end of the second millennium B.C. Many earlier migrations from Asia had reached Europe before

this, just as the same migration zone had reached America *via* the Bering Corridor. It is possible that this explains the slight similarity between Basque and the Amerind speeches.

This complex structure may even represent a stage in the early development of the Aryan speech, which survived among some allies of their primitive forerunners, who had long ago migrated from the homeland. An exactly parallel case is the survival of primitive Norwegian in Iceland, or shall we say, the presence of Shakespearian dialects among the folk in the rugged hills of the Eastern United States.

But a curious anomaly is that the Basque tongue is used by broad-headed Alpines (87) in the north of the Basque territory in France, and also by narrow heads (77) near Bilbao in Spain. Possibly neither were the original speakers of Basque, just as it is certain that the Scottish Highlanders are not of the same race as the original speakers of Gaelic.

It is said, that as a result of isolation, there is a preponderance of rather pointed chins and of broad brows throughout the Basque area (though the writer was not able to detect it on a recent visit). This facial trait may have been recognized among the early Basques, and so may have been intensified by the strong national feeling of the race, which may easily have led to such features being an attraction in marriage.

Leaving the Basque people, let us proceed northward. We find on the east in the hilly Cevennes a fairly uniform group of short, dark broad heads (86) known as Cevenoles. They are the veritable apex of the Alpine wedge which was thrust into Europe from Asia at some time in the Neolithic period. From the Cevennes eastward to the China Sea we are dealing with brachycephs of one type or another, and to this great body of cognate peoples the term Alpine Mongolian may provisionally be given. We find that in France as elsewhere in Europe they are confined largely to the mountain areas. This suggests that they were early immigrants who have been driven into unattractive regions by stronger and later immigrants (see Fig. 66).

A little to the north and west of this "Alpine wedge" is a most interesting group of peoples who have settled for ages in the Dordogne Valleys. They comprise folk with very narrow heads, who are dark in colour and of low or medium stature. It is precisely here that the most remarkable relics of Palaeolithic times have been found in the limestone caverns, and it is here that the most primitive peoples of

France still survive We may accept the conclusions of Collignon and others who believe that the Cro magnon types have been preserved here with little change for some fifty thousand years at least Near Perigueux half the people have a head index of about 77, which is the lowest of any district in France

Proceeding north once more we find an entirely new race becoming more and more abundant These people occupy the valleys and cluster about the towns They are obviously later comers, since they still occupy the "corridors of migration" They are tall, fair people

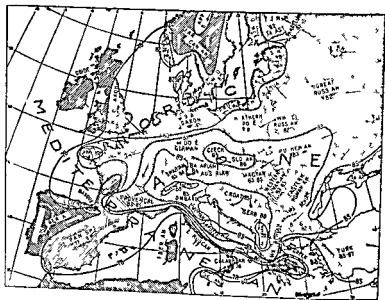


FIGURE 67 —The race map of Europe showing the relation between linguistic and national groups and the three races Nordic Alpine and Mediterranean (From *Geographical Review* 1921)

with heads of medium width (80 or 81), and belong to the Frankish tribes of the family commonly known as Nordic Their distribution shows that they came in from the north east, by way of the northern plains of France and Germany

Our next stage brings us to the coast near Brittany Here again we come on a most interesting and rather difficult problem in European ethnology The Bretons are largely dark broad heads (some districts averaging 86) but they are by no means a pure Alpine stock Their

language is Brythonic, allied to the Welsh speech. It is believed that many of the Bretons were driven from the west of England by the Saxons about the fifth century A D. Hence the similarity of language, but there is very little similarity in race between the Cornish and Welsh "Brythons" on the one hand, and the Breton "Brythons" on the other.

It seems probable that these brackeph Britons are actually descended from the Alpine Keltae who invaded Britain about B C 200, and taught the dark dokeph aboriginals the Welsh tongue. This brackeph "aristocracy" was driven out of England by the Anglo

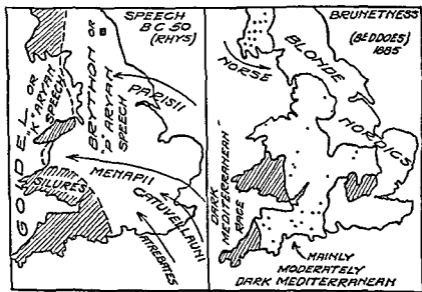


FIGURE 68—Two maps of England showing (on the left) invasions of Britain by Welsh speakers (in part Belgae tribes) a few centuries before Christ and (on the right) the present ethnic classes

Saxon invasions, leaving their language behind, however, among the British peasants

B Cultural Groups in Britain

Crossing the Channel we reach Britain. Here we find three major languages still spoken by three zones of people. To the west is a fringe in Ireland and the Scottish Highlands who speak Erse and Gaelic (Ancient Erse may be described as the ancestor of Gaelic). In the intermediate zone is the Cornish-Welsh Manx group, of which Cornish is now extinct. In the east is the Anglo Saxon group, now

spoken as English in the south, and "broad Scottish" in the north (Fig 68 B)

These three zones undoubtedly represent thrusts from the east, the "primitive being pushed to the wall" Here again detailed ethnological investigation shows little connexion between physical anthropology and language It seems possible (though not certain) that the typical Anglo Saxon of Central and East England, a fair, tall person with a medium skull (78), speaks a modern form of his original Aryan tongue But what of all the peoples to the west? Certainly the dark short narrow heads of Devon have changed their language They are Mediterranean folk akin to those of North Africa, and in all probability they spoke something like Berber in early Neolithic times The same is probably true of the similar folk (with a head index of about 75) who occupy South Wales and formed the Silurian tribes¹

We shall do well to follow Fleure and James in attempting to elucidate this complicated problem² It is difficult for Britislers to realize that their islands were a refuge for a debris of broken tribes pressed out from Europe, akin in some ways to the shattered tribes found in similar positions all round the Old World land mass

C Welsh Stocks

Fleure has investigated in great detail the stocks found in the somewhat inaccessible regions around Aberystwyth in West Wales (Fig 69) His conclusions are somewhat as follows In the south are numerous folk belonging to the short, dark, primitive Iberian (i.e., Mediterranean) stratum but in the hills there are still older peoples Near Plinlimmon is a "nest" of extremely narrow headed people who still show some of the features of Neanderthal man¹ They have very flat skulls low foreheads, and marked glabellas, with a head index often as low as 73

In addition to these two long headed types there are two broad headed groups One of these is a dark type, found near the coast, and like the maritime rovers of the Mediterranean Neolithic settlements There is further a tall, fair, or red group of Alpines with high noses and prominent brows, who exerted a peculiar influence on Britain in early Bronze times Fleure speaks of them as a "turbulent, noisy, mobile aristocratic people" whose exploits filled the history of those times They seem to be allied to the folk buried in Round Barrows,

¹See the author's *Environment and Nation* p 107

²In *Journal of the Anthropological Institute* London, 1916

who used beaker shaped utensils. They occur widely in Western Europe, notably at Borreby near Copenhagen. They perhaps entered West Wales along the valley of Bala Lake.

The racial history of the British Isles seems to have been something like this. It is probable that the type in the Plinlimmon region is directly descended from the very long headed Aurignacian type. Secondly, there is a type belonging to a generalized stock which can hardly be distinguished as either Mediterranean or Nordic. The Long Barrow men, whose average cephalic index is about 72, are of this strain. Thirdly, we find that the most numerous types are members of the Mediterranean stock who probably introduced the early Neo-

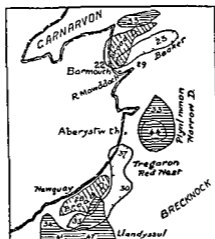


FIGURE 69—The three racial components in Western Wales. The figures give the percentage of the local census. (After Fleure and James.)

lithic culture. Finally, there are at least three different types of brachycephs, all ultimately connected with the Alpine race, but differing somewhat from them. The most distinct of these types are now usually termed the "Beaker Folk." They are also sometimes called "Bronze Age People" or "Round Barrow People." Their average cephalic indexes vary from 80 to 84, the latter figure being more frequent. At present there are practically no skulls in our museums belonging to the Early Iron Age, but it is probable that during this period the Nordic type became more and more frequent in Britain. The Anglo Saxons who arrived in the fifth century were, of course, Nordic. The Nordic Alpine type of the population has since that time been usually overlaid by strata not dissimilar in type. Finally,

there is evidence that 200 years ago the cephalic index was 77, today it is probably about 70

D Deductions from Place Names

An investigation of the place names of Britain is of considerable interest, as showing how the various migrations have displaced preceding languages in common speech, but have preserved the original place names. This is of course, a world wide phenomenon. Thus in Sydney, Australia, no full blood aboriginal now lives within 100 miles of the city, but names of leading suburbs such as *Wooloomooloo*, *Maroubra*, *Cronulla*, or of the National Park—which is *Kuring gas* after the old tribe—keep alive the memory of a vanished race.

Canon Taylor suggests that the syllable "etan" in Britannia, Aquitania (Dordogne), Lusitania (Portugal), and Mauretania (Morocco) is a non Aryan word, and means "country" in some language akin to the earlier Hamitic speech. Such words are perhaps the earliest in Europe.

"Avon" and "Esk" are two Gaelic (?) words common in Saxon Britain. Pen (mount) corresponds in Welsh to "Ben" in Gaelic. It is found not only in Wales but in the borders of Scotland, which were originally occupied by *Welsh* people. In many ways it is clear that the Goidelic (Erse and Gaelic) people were driven west by the Brythonic (Welsh), who again moved ahead of the Saxons about the fifth and sixth centuries A D.

It is quite possible that few of the genuine Brythonic people of the Aryan migration from Asia now speak their own language. They taught their speech to their conquered subjects, but it is not unlikely that only the latter speak Brythonic, though as stated formerly, perhaps the Bretons escaped the merging which befell their congeners.

Indeed, it seems possible also that Gaelic had a similar history. It is so like Brythonic (the two are allied somewhat like Latin and Greek) that the original speakers may not have been very unlike. If we postulate moderately broad headed Brythons (like the Breton) as the first Welsh speakers to enter Britain, then it seems hardly likely that the dark narrow headed Scottish Highlanders were the *original* Aryan Goidels or Gaels. Rather would the first speakers of Gaelic be like the ancient Gaulic broad heads of France. However, sufficient has been written to show the complexity of the problem, and the danger of trusting language as a key to race. We return to this question on page 189.

In summary, we may picture the Cro magnon and later Palaeolithic folk as giving rise to the Silurian (Mediterranean) substratum. This was invaded in Neolithic times by Goidelic folk who impressed their language on the Silurian clans. Much later, and in Fleure's opinion not many centuries before Caesar's visit, entered the Brythons, whose arrival repeated the history of the Gaelic changes. Many of these Keltae belonged to the same tribes who gave their names to places in France. Thus the Parisii (Paris) settled in Yorkshire, the Menapii (Menin) reached Central Wales, and even settled in East Ireland. The Catuvellauni (Chalons) lived near London, while the Atrebates (from Arras) conquered Hampshire (see Fig 68 A). These brakeph invaders were, however, not numerous enough to alter the race composition greatly. Then the Romans made a brief conquest which was of little ethnological consequence. For several centuries the Romano-British governed the country, but they were in turn overcome by the Anglo-Saxons (in the fifth century) and slowly driven into the borders or into France.

Britain of today really seems to be chiefly occupied by the original Silurian stock and the later Saxon immigrants, and these have mingled with each other and with the various strains of brakephs mentioned above (Fig 68 B).

E Racial Stocks in Germany

C. W. Coon in his recent book *Races of Europe*³ shows that the chief areas of the Nordic race occur in Scandinavia, Finland, and Britain. The southern portion of Germany is Alpine, but the "Northern Plain" area, though it contains various hybrids with Nordics (called by Coon "Norics") is preponderatingly "Palaeolithic" in descent. These are big-headed, primitive, survivors of the Neanderthal hunting period. They are found in the purest state in the Fehmarn Island near Kiel, and Coon calls them the *Borreby race*. In his opinion many of the pure Nordic type vanished during the terrible wars of the Reformation.

³New York 1939

CHAPTER XIV

THE CLASSIFICATION OF THE RACES OF EUROPE

A Races and Culture Groups in Europe

In the foregoing chapter dealing with the races in and near Britain we have met with types belonging to the three major ethnical divisions. Thus the folk of the Dordogne and of western Britain belong to the lower Mediterranean race, the Franks and Saxons belong to the so-called Nordic race, and the Cevenoles are members of the central Alpine race.

The following table (see also Fig. 67) shows that there are some forty distinct ethnic cults in Europe. It has seemed logical to divide them into five major classes: primitive Mediterranean, Nordic, and three groups of the Alpine peoples. Of the latter the speakers of non-Aryan languages may first be separated off, remembering that they are mostly just as true Alpine groups in an ethnical sense as the others. Secondly we may divide the Aryan Alpines into broader and narrower headed Alpines.

If we plot these races as shown in the map (Fig. 67) there is seen to be a regular arrangement in these zones of peoples. All round the western margin are the very narrow headed Mediterranean folk. These form the lowest stratum and it still persists in Scandinavia, Western Britain, South West France, Portugal and upland Spain and in parts of Italy and Greece, and forms an element in the coastal population of all the Mediterranean. Next comes the Nordic zone, most prominent around the Baltic and North Seas. The great central wedge of Alpine peoples is connected with the central peoples of Asia, though the common practice of separating Europe from Asia has hidden the close continuity. The main body of Alpine peoples are of moderate stature, rather dark with brown or black hair and with a cephalic index of about 84. They constitute the South Germans, Austrians, Eastern French, Northern Italians, Swiss, Czechs, Rumanians, Serbs, etc., and also such non-Aryan folk as the Magyars, Turks, and Tatars.

In the same general category also come the main body of the Slav folk of Russia and Bulgaria and Greece. The remaining ethnic stocks are not yet fully correlated. Of these are the Lapps who are early-comers, allied to the Samoyede tundra-dwellers of Asia. The

CORRELATION OF THE COMPONENTS OF THE CHIEF NATIONS OF EUROPE (GENERALIZED)

<i>Country</i>	<i>Early Mediterranean (cephalic index 75-7)</i>	<i>Nordic (cephalic index 77-80)</i>	<i>Brakeph Alpine (cephalic index 81-4)</i>	<i>Hyper-brakeph Alpine (cephalic index 85-8)</i>	<i>Altaic Alpine non Aryan (cephalic index 81-7)</i>
Ireland	Most	Some in east			
Scotland	Highlanders	Most in east	Shetlands		
Wales	Many in south		Few "nests"		
England	Many in west	East	Kent?		
France	Dordogne and south	Most in north	Cevenole	Savoyard	
Germany		Prussians Saxons, etc	Bavarian (Austrian)	Swabian	
Spain	Most		Few in north		
Portugal	Most				
Norway		Bulk of people	Few in south-west		Lapp (87)
Sweden					
Switzerland				Swabian Ladin, etc	
Italy	Corsican and south		Lombard Umbrian	Savoyard Ladin, etc	
Greece	South		Many north	Albanian	
Bohemia			Czech and Pole		
Poland					
Yugo-Slavia			Most		Turk (85)
Hungary		Some Teutons			Magyar
Rumania		Some in east	Most		
Bulgaria		Some in east	Bulgar		Turk
Russia		Some Teutons	Most		Tatar (85) Finn (80)

Lapps are thus remote from any European stocks. Their language is somewhat akin to Finnish, but this does not indicate a common ethnical origin, for the Lapps have a remarkably high head index (87), while the Finn, in addition to many other physical differences has a relatively narrow head (81).

The Turk is linguistically and culturally remote from the European races. But, in part, owing to the habit of the Turkish warriors of marrying European women, the resulting Turkish race (in and near Europe) is ethnically very close to the neighbouring Alpine folk of Europe. Moreover, probably the original Turkish invaders were largely made up of tribes akin to the earlier European settlers.

There remain only a few very interesting peoples in the mountain regions around the Adriatic. They are characterized by extremely broad heads (88). In the west is the (Savoyard Latin) Swiss group, in the east are the Albanians. These are probably very early migrants into Europe.

B *Classes of Deniker and Dixon*

Having now briefly discussed the racial affinities of the European peoples, we may compare the previous classification which is not unlike that advocated by Ripley, with the schemes of Deniker and others¹:

It will be seen that Deniker places more reliance on hair colour than on skull index. The latter character surely withstands a variable environment better than does the colour of the hair. Moreover, his four sub races (sub Northern, Vistulan, North west, and sub Adriatic) differ only to a small extent from four of his major races (Nos 1, 2, 5, and 6). Of the six major races the Iberian (No 5) and Nordic (No 1) are much the same as those given in the two first columns of my long table of the 'Components of the Nations of Europe' (p 181). The other three main groups (Nos 2, 4, and 6) are Alpine stocks of which the Eastern and Cevenole are merged by the writer into the narrower-headed Alpines, and the Adriatic agrees fairly well with the broader-headed Alpines. Deniker's "Littoral Race" (No 5) is one of small numbers and importance, which may well represent a fairly direct survival of the Palaeolithic peoples, as he suggests. Von Eickstedt in his recent book *Rassenkunde* (1934) also splits the Alpines into three groups close to Cevenole, Adriatic, and Eastern.

Roland Dixon in *The Racial History of Man* has raised novel

¹A recent discussion of these classifications is given by von Eickstedt in *Zeitschrift für Rassenkunde* Stuttgart July 1937.

DENIKER'S TEN ETHNIC STOCKS IN EUROPE

No.	Name	Locality	Cephalic index	Stature	Eyes	Skin	Other names
Ia	Northern	North of Europe	76-9	Very tall	Blue	Ruddy	Nordic, Cymric, Germanic
Ib	Sub-Northern	North Germany	80	Tall	"	"	"
IIa	Eastern	Russia	82	Short	"	White	Slav, Alpine
IIb	Vistulan	Poles	82	Very short	"	"	"
III	Iberian	Spain, Perigord, Corsica, Western Italy	75	"	Very dark	Tawny	Iberian Mediterranean
IV	Cevenole	Central France, Alps, Hungary	85	Short	Brown	Darker	Alpine Rhaetian
Va	Littoral	Tiber to Biscay	79	Tall	Dark	"	Celtic
Vb	(North-west race)	Ireland and Wales	76?	"	"	"	Cro magnon?
VIa	Adriatic	East Adriatic, Ladin, Albania, Ardennes	86	Very tall	"	Tawny	Alpine (Dinaric)
VIb	Sub-Adriatic	North-east France, Bohemia, Lombardy	84	Tall	"	"	Lorraine

A. Fair-haired

B. Dark-haired

issues I have here epitomized his conclusions as regards classification in general and as to the racial stocks in Britain

In 1923 he published a study of racial distribution which agrees in many fundamental principles with my own views, published in 1919, he also groups the races of men according to head index, but uses nasal index in addition. Thus he obtains four main types each of which is subdivided according to whether the skull is low (primitive) or high (In his maps however, he ignores this subdivision)

The relation with more familiar classes and with those in this book is indicated in the table on page 185

We note that there is no place in Dixon's major groups for the zone of peoples with a head index between 73 and 82, a place usually filled by the Nordics. The oft-quoted racial purity of the Nordic races (78) is replaced by a mixture of Asiatic, Negro, and "Dago" types. In fact Dixon thinks that the Nordic race is primarily a mixture of groups 2 and 3 as given in the adjoining table. The writer, as stated, believes that the Nordic is a 'bleached' Mediterranean, who moved westward, like the latter, from Central Asia but by the cold northern route (p. 53)

Dixon's views as regards Britain may be summed up somewhat as follows. The Piltdown skull is a blend of 'Mongoloid' and 'Proto-Australoid' types. The Palaeolithic relics seem to belong chiefly to the 'Proto-Australoid' type. The dawn of Neolithic times was marked by many 'Long Barrow' people of 'Mediterranean' type while the 'Caspian' type is less frequent. "Palaeo-Alpine" folk are well represented however. During the Bronze Age, with its Round Barrows the skulls were largely of Dixon's 'Alpine' type, but some of the Ural type appear also.

The Saxon invasions brought in large numbers of 'Mediterranean' type with a considerable 'Caspian' element but the "Angles" have an unexpectedly large 'Proto-Australoid' element, while the West Saxons have a strong 'Alpine' strain. The old crypts of the Middle Ages in Kent show a similarly marked "Alpine" constituent in their skulls. From London, however, the crypts show a majority of "Mediterranean' and some 'Proto-Australoid' and 'Mongoloid' forms. These are probably a survival of pre Neolithic British people.

Thus the Teutonic or "Nordic" type of other ethnologists is stated by Dixon to be 'an ancient blend of Mediterranean, Caspian and Proto-Negroid types. England has escaped the general

brachy-cephalization to which the large part of the mainland has been subjected "

RACES OF THE WORLD

(According to Roland Dixon)

<i>Dixon-class</i>	<i>Usual name</i>	<i>Locality</i>	<i>Skull</i>	<i>Cephalic index</i>	<i>Nasal index</i>
1a Palae-Alpine	Negrito broad head	Philippines Burmese Valais	High	83	54
1b Mongoloid	Primitive Alpine (?)	Lapps Bushmen Switzerland	Low	"	"
2a Proto-Negroid	Negro	Gaboon Iroquois Papua Brazil	High	72	55
2b Proto-Australoid	Australian	Australia California Sicily Ostia	Low	"	"
3a Caspian	Mediterranean	Russia Eskimo Sardinia Japan	High	72	44
3b Mediterranean	'	Egypt California England India	Low	"	"
4a Alpine	Alpine	Swiss Hawaii Araucans Czech Armenians	High	84	44
4b Ural	"	Swiss Kalmuk Basque Venezuela	Low	"	"

It is not so much the classification suggested by Dixon which is of interest as the way in which he demonstrates that the types ramify *all over the world*. This is a thesis which the writer had already promulgated four years before.¹ Many orthodox classifications of today still appear to cling to the out of date idea that each continent has its own special racial type. So we find terms like Caucasian American etc. still used in text books. In a later chapter the bearing of race migrations on racial classification will be discussed more fully.

C *Race and Language in Europe*

Since nationality is almost entirely a question of common environment we shall do well to consider some aspects of this factor at the present stage of our discussion. We may profitably contrast France with the Austrian Empire of yesterday. In France we see at least three or four different races living harmoniously together united primarily by a common language. These are the primitive Iberian of the Dordogne the Nordic Frank of the north-east the dark Breton of the north and of the Cevennes and finally, the extremely broad headed Savoyard in the east. Although now dwelling in harmony their cultures and languages must have been extremely diverse in the past.

Before 1914 the Austrian Empire consisted of five distinct nations unhappily linked together and controlled by an alliance between the western German speakers and central Magyars. Thus on the north were the Western Slav races of Bohemia Moravia and Silesia. On the south were the Southern Slav races of Bosnia and Servia speaking different languages and of different religions from their cousins in the north. On the east were the Rumanians who speak a mixed Romance Slav language. The Magyars (pronounced *Moj yar*) speak an Asiatic tongue allied to Kirghiz and Manchu. The dominant Austrian race (in Vienna and the Tyrol) speaks German and is almost identical with the South German (see Fig. 67).

Yet if we examine these peoples by anthropometric criteria as given on Biasutti's charts we find that they all have the same cephalic index (about 84). They all have a similar colour of the skin and hair. The hair is wavy throughout. The stature is uniform except that the South Slavs are a little taller than the rest. The limb proportions are the same throughout. The facial index shows that all have broad faces while the nasal index is uniform.

¹In the *Geographical Review* New York 1919

We must come to the conclusion that ethnically all these varying "cults" (i.e., cultural groups) are really brothers in one family, however much they have varied in their widely separated journeys from the same Asiatic cradle land. Differing religions, cultures, trade rivalry, methods of printing (i.e., Roman or Russian type), and, above all, language differences have kept them apart and intensified national jealousies. It is not any specific race difference which has done this, for it is non-existent. If these peoples could forget their past animosities they could amalgamate in one or two generations into a strong common nationality founded on practically identical racial origin.

It therefore will be well to examine the question of the European languages to see something of how some of these artificial barriers have arisen. We may consider the Aryan languages first. "Aryan" is here used to specify the group of allied languages extending from Ireland to India. It is sometimes called the Indo-European group of languages (Fig. 70). They are usually subdivided into two main groups, conveniently known (by the words for "hundred") as the "kentum" and "satem" groups.

The main groups and sub-groups are illustrated in the following table in a somewhat generalized fashion. The spelling of the examples is simplified to indicate the pronunciation to the layman.

We can see in this table and in the adjoining figure a general resemblance between the zones of language and the zones of ethno-

CLASSES AND DISTRIBUTION OF ARYAN LANGUAGES

Early <i>Kentum</i> type		Later <i>Satem</i> type	
Largely Mediterranean	Partly Nordic	Largely Alpine	Largely Alpine
Primitive K West Europe	Later P Central Europe	East Europe	South west Asia
Gaelic	Welsh	Lithuanian	Sanskrit
100 = Keud 5 = Keug	100 = Kant 5 = Pump	100 = Szimta 5 = Penke	100 = Satem 5 = Panch
Latin	Greek	Slav	Armenian
100 = Kent 5 = Kink (or Pink)	100 = Katon 5 = Pente	100 = Sito 5 = Pietz	5 = Pese

century went there, and stagnated in certain rugged regions for three centuries. Meanwhile, English in Central England had advanced very materially under the stimuli of contact with new peoples and ideas. We may note that it has been seriously stated that Sanskrit originated in Lithuania¹. This is against all the evidence of racial and linguistic distribution and we may be sure that Lithuanian is a 'migrant Sanskrit' preserved for centuries by isolation. So also Icelandic preserves the original Norwegian. In fine, we may see here another example of the great *Law of Zonal Evolution*—that the primitive forms are found precisely where they did *not* evolve and that the *centre of evolution* is where the stimuli were strongest and where the latest form now occupies the summit of a series of buried 'layers' of evidence arranged in the same order as the zones.

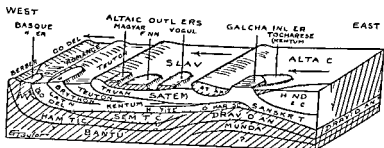


FIGURE 71—Block-diagram (from West Europe to India) showing the Zones and Strata Concept applied to migrations of language. The earliest languages are found in the West. Notice the Inlers of older speech surrounded by younger speech (e.g. Basque and Tocharian) and the Outlers of later speech covering older speech (e.g. Magyar). Early Kentum speech shown dotted. The layers are much generalized.

Many books have been written in an attempt to discover the birth place of the Aryan languages. If we study the distribution of the primitive (or *kentum* languages) at the dawn of history, we find them in the *Ukraine*² in *Anatolia* (Hittite) possibly in *Sumeria* and more certainly in the *Thian Shan* in Central Asia. In the latter region Tocharian was spoken at the time of Christ, and was a generalized language with curious affinities with Gaelic, Latin Slavonic, Armenian and Greek³. If we plot these four regions (as black triangles in Fig 70) we are again led to the Caspian area as the probable cradle land from which the Aryan languages spread out. Since this area is

¹See Harold Peake *The Bronze Age and the Celtic World* (London 1922)

²V. C. Childe *The Aryans* (London 1926)

wholly inhabited by the Alpine race, it seems likely that Aryan was first spoken by this type rather than by the Nordics

In an earlier chapter, I have shown the value of using the geological terms "outlier," "inlier," etc., in connexion with these ethnic problems. Much confusion has resulted because many languages have been preserved by three major methods, which result in what may be termed fossil highland, and migrant varieties. The last is the most important and the other two are often wanting. For instance, Sanskrit is a *fossil* language buried under later strata of Prakrit, Pali, Pushtu, etc. Probably its *migrant* form, as stated above, is best represented in Lithuanian, but it is very important to realize that the Galcha mountaineers on the Hindu Kush (Siah Posh dialect) have preserved a very close approximation to the ancient Sanskrit (see Fig 71). Thus Galcha is the *highland* form.

In the map of Europe the Basque region is an inlier of primitive speech, which projects through the surrounding waves of Romance languages. The Pelasgian relics in Greece are inliers amid the much later languages which constitute Greek. In China the Lolo peoples occupy an inlier amid the encircling Mongolians. The Tocharian speech was an inlier among Mongolian languages (see Fig 71).

Outliers are more numerous in Europe, and the three Asiatic languages are Lapp, Finn, and Magyar. Their congeners are to be found far away in Siberia, but we know that for a time these tribes extended right across Russia. They all belong to the great rival group of Ural Altaic languages which flank the Aryan tongues on the north-east. Present-day Asiatic members are the Kirghiz and Tungus. The Lapps entered Europe in days long preceding history. The Finns were in Russia and Finland when we first know anything of the history of Northern Europe. The Magyars were a later horde akin in race and language, who entered Europe in the ninth century. They were a later swarm than the Finns, who probably came from the same cradle land near the Altai Mountains (see Fig 70).

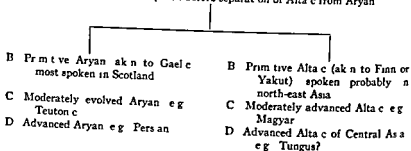
We may conclude this brief discussion of the racial aspects of the languages of Europe by referring to the concept discussed in an earlier chapter (p 50). We may postulate two groups, say, the Primitive Aryan and Primitive Altaic tribes living not far apart in Central Asia. In the course of evolution and migration these primitive tribes widely separate, and their components evolve and differentiate very greatly. The interesting deduction is that the linguistic analogies between the two great groups may be found to be closest in case of the very distant

tribes preserving the most primitive characters of each. Thus Gaelic (Primitive Aryan) may more closely resemble some primitive Altaic tongue on the periphery of north-east Asia than do any intervening Aryan and Altaic languages.

So also the links of Aryan and Semitic tongues are not to be found in Mesopotamia where the two touch but very probably in Scotland and in Abyssinia for there should be found the primitive speeches of tribes who may have lived near each other in earlier days.

This may be illustrated by a hypothetical table

A Primitive Asiatic speech before separation of Altaic from Aryan



On the theory of *zoning* the primitive common Aryan Altaic speech might be best preserved and studied in the Gaelic on the one hand and say (for the sake of argument) Yakut in far Northern Siberia. So far as I know no one hitherto has used this principle for investigating the common ancestry of languages widely separated today.

A somewhat similar line of argument should be useful in discovering the relations between the Aryan and Semitic tongues. Here again there is little affinity between say Syrian and Greek but I can imagine that *Gheez* (an ancient Semitic tongue in Abyssinia on the outer boundaries of the Semitic zone) might show certain distant similarities to *Gaelic* the most primitive Aryan language.

(It is interesting to note that the Italian philologist A. Trombetti advanced somewhat the same theory as to the value of studying marginal languages (so as to identify the original speech) about two years after my own theory was published. A very interesting study in this field is the recent volume *Gift of Tongues* by Margaret Schlauch¹)

¹New York 1940. See also the author's book *Our Evolving Civilisation* 1947.

D Fundamentals of the Present Population

The positions of the chief crops and minerals of Europe are charted in Fig 71a. They are added for the reasons given in the preface. In the main map the best belts (optima) for the various crops are charted in a generalized fashion. Associated with many of these belts are the appropriate summer temperatures. Thus there appears a regular sequence of crops arranged in the following order, starting in the north: Hay, polar barley, flax, potatoes and rye, oats, winter wheat, spring wheat, maize, olives, and subtropical barley. (See map on p 194.)

The great Russian Shield in Europe (Fig 55) is largely covered by deep younger deposits, and so its metallic contents are not available. The metals are found largely in the smaller relic blocks due to the wearing-down of the Permian Folds shown in the same map. Accordingly we find copper, mercury, lead, and iron in these rocks in Spain. Lead occurs in similar rocks in Sardinia and in Greece. Along the northern edge of the Alpine Folds are similar relic blocks, with copper at Mansfeld, lead in Poland, and iron and manganese in the Podolian relic block in South Russia. The richest area of all is found in the core rocks of the Permian Folds of the Urals. Here copper, chrome, platinum, gold, and iron are indicated in the map.

The coal resources are charted in the inset map in Fig 71a. There is an elongated "trough," which is shown in section at the right of Fig 55, where in Carboniferous times (some 200 million years ago) conditions were favourable for the growth of masses of peaty vegetation. Hence there is a continuous series of coalfields from Scotland south and east to the Donetz Basin in south Russia. There is not much coal of note in Europe away from this "Coal Trough." Oil is found only in two regions, both flanking young mountains. One of these borders the eastern side of the Carpathians, with its centre near Ploesti. The other is much richer, and lies on the northern flanks of the Caucasus, and extends from Maikop to Baku. The iron ore of Lorraine and Cleveland is derived from bog iron ore, which was deposited in the Jurassic beds of Western Europe. The Kiruna deposit in North Sweden is of quite different origin. Valuable deposits of apatite containing phosphorus are found in the rocks of the Shield of the extreme north of Russia. Bauxite (for aluminium) is found in the south of France and in West Hungary.

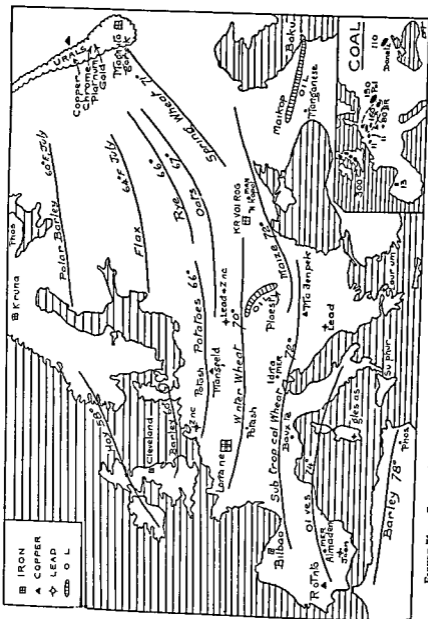


FIGURE 71a—Crops and minerals of Europe. The July temperatures are noted in a number of cases. Inset are shown the chief coalfields in the Coal Trough. BR indicates brown coal. Figures give coal reserves in thousand million tons.

CHAPTER \V

THE CHANGING ASIATIC ENVIRONMENT

A The Build of Asia

Our study of Europe (the north western "peninsula" of Asia) will prepare us for the chief topographic features in the latter continent, while the southern portion of Asia in some respects recalls African topography. The huge continent consists of four broad belts running approximately east and west (Fig 72). In the north centre is the Angara 'Shield' mentioned in an earlier section. This is separated from the Russian Shield only by the Ural Warp. On the west it is buried under the silts of the Siberian Plain carried down largely by the Rivers Irtysh, Obi, and Yenesei. On the east the "shield" is somewhat more elevated and is naturally considerably dissected in consequence.

All round the southern margin of the great shield is a broad zone of elevated land, which in far past geological times was crumpled against the shield. But it has long been more or less levelled by erosion, and the last phase of earth movement was to break it up into a series of fault blocks, especially in China, Manchuria, and Japan. Some of these blocks in Japan near Tokyo are sketched in Fig 72 (inset). Indeed, as we saw in Europe, the region between the latest axis of folding in the far south and the resistant shield in the north has been the scene of gigantic foldings in the earlier geological epochs. A cross section (along the section *NS*) is given in the upper right portion of Fig 73. It has the same structure as in most of the other continents.

The next belt consists of the weaker, more mobile portion of the Asiatic land mass. The great Sea of "Tethys" extended across Asia in Triassic and later times, and this yielded to the folding forces which reshaped the world in Tertiary times. No story in the geological record is more interesting than that which recounts the birth and uplift of the giant Himalayas. Moreover, this region is precisely that in which, according to many ethnologists, man's cradle land was situated. We may well, therefore, consider in some detail the changes which have taken place in Turkestan, Tibet, and India since early Tertiary times.



FIGURE 72 — Block-diagram of Eur. As. The nets show typical fault blocks near Tokyo. The lower section indicates differential movements in the earthquake of 1923.

During the Eocene, there seem to have been deep seas through North-Western India and through Southern Turkestan. In these were deposited vast beds of the large foraminiferal shell *Nummulites*. These are now found 18,500 feet above sea-level, near Ladak on the Upper Indus. According to Pascoe, whom I quote largely in the next few paragraphs,¹ considerable movement has taken place since the Pleistocene, and it is more than probable that such movements are still progressing (see Fig 74)

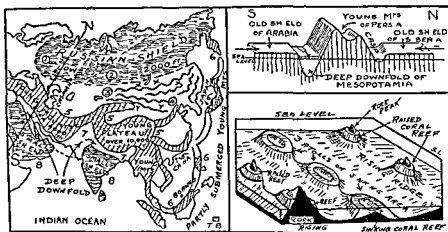


FIGURE 73—The structural units of Asia are the Angara Shield (1 and 2), ancient Fold-Relics (3 and 4), Young Folds of Alpine Storm (5 and 6), Downfold (7), and portions of African Shield (8). A typical cross-section of a continent is given in the top right figure. A block-diagram of a small area (T B) near the Celebes appears at lower right corner.

The great Ganges earth-trough subsided since Eocene times, and is now 20,000 feet deep, though filled with river deposits to a height above sea-level. At this time, perhaps, there were two seas, one north of the Himalayan region through Ladak, and separated by a long land-belt from the "Indo-Gangetic Sea" to the south (see Fig. 74). In the Miocene this southern sea became a brackish gulf, and later perhaps a series of lakes. In the Pliocene there was probably a great river, the "Indo-Brahm," flowing from Assam to the Arabian Gulf. There seems to have been fairly high land connecting the Deccan (or Gondwana) Plateau with the Garo Plateau of Assam. The Ganges outlet did not develop till very late in Tertiary history.

¹"Early History of the Indus and Ganges" (*Quarterly Journal of the Geological Society*, 1920)

Meanwhile in Tibet a parallel river seems to have developed which led the drainage down into the Oxus (or Aral Sea)

An interrupted hydrographic line [extends] from Pemako to Gilgit, represented to-day by the Tsangpo river the Manasarowar lakes the uppermost reaches of the Sutlej the Indus and the Shyok and perhaps the Gilgit river beyond. It seems very likely that this was once a continuous river (the Oxus) running westward. At the present time the Indus at Bunji where it abandons its north west course and turns southward is 3 400 feet lower than the Brahma putra where it leaves the same geotectonic line. In spite of its immense

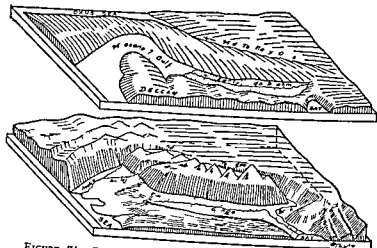


FIGURE 74—Evolution of the Himalayas. Topography in middle tertiary times indicated above present topography below (Data partly from Pascoe)

elevation the Tsangpo is a sluggish navigable river south of Lhasa and has cut no deep basin for itself in Tibet. The Indus on the other hand has cut its bed to a low level on the Tibetan Plateau. That portion of the modern Indus which runs just below Bunji is of no very recent construction as shown by the colossal depth of its gorge which is nearly 17 000 feet. The steepness and narrowness of the gorge are witnesses to its immaturity but its immense depth and the hardness of its rocks place a limit to our conception of its youth.

(The present writer would point out that the depth of the gorge depends primarily on the amount of uplift and he is prepared to believe that most of this enormous cutting may have occurred in the Pleistocene.)

Very interesting changes have occurred in the Indo-Gangetic Plain

in Pleistocene and later times. Probably the Tsangpo first emptied into the Irawadi, then into the Megna, and then still further west into the present Brahmaputra. Possibly folding near Calcutta led to the Upper "Indo Brahm" River being captured and joining the Tsangpo. The Ganges is now capturing the (present) Upper Indus tributaries. Old Hindu legends indicate the capture of the Saraswati by the Ganges, while much more convincing is the fact that the common dolphin of the Indus (which never enters the sea) is found in the Upper Ganges also. So also some of the *Chelonia* in the two basins are identical.

This lately crumpled portion of the Asiatic continent is, of course, an extension of the "Alpine" chains of Europe. The latter seem to have developed chiefly in the Miocene period, while the Himalayas are usually referred to the Pliocene. The juvenile drainage scheme, (for instance, the six crowded rivers shown in Fig 36), and the volcanic action at the Burmese end of the chain, seem to indicate that the eastern end is still the most active portion of the whole system. The almost constant earthquakes and the immense series of volcanoes (over one hundred in number) somewhat to the east in Java point to the same conclusion.

The plan of the Tertiary fold ranges is that of two more or less parallel chains "knotted" at the Pamirs and spreading widely apart at the east end. This conformation has separated the north from the south of the continent to a much greater degree than obtains in any of the other great land masses. Only at one place (south of Merv) is there a low pass of 4,000 feet from the Siberian lowlands to the Indian Ocean. Through here, as we shall see, the Alpine races poured into India.

THE BUILD OF THE ASIATIC FOLD MOUNTAINS

Structure	West			Central knot	East	
Northern chain	Caucasus	Elburz	Hindu Kush	Pamirs	Thian Shan	
Central basin	Black Sea Kur Valley	Iran	Seistan		Tarim	
Southern chain	Taurus	Zagros	Suliman	Pamirs	Himalaya	Burmese Alps

Between the two chains extends a long series of elevated basins and plateaux. This sequence is conveniently indicated in the table (partly based on J. W. Gregory) on page 199.

To the south of this somewhat complex series of late Tertiary folds lies a number of huge crustal hollows of which the chief are the valleys of Mesopotamia, of the Indus, and of the Ganges. The Persian Gulf links the valleys together. These basins were formed when the mountains arose, and in some respects resemble the "deeps" of the ocean where the mighty tectonic (folding) mechanism is in operation (Fig. 4). These hollows have in three cases become filled with thousands of feet of river silt, and so support immense populations especially as the rivers, which naturally occupy the central portion, are suited for irrigation.

Finally, the peninsulas of Southern India and Arabia are relics of ancient crustal blocks which have been land surfaces since Paleozoic times (Fig. 73). It is probable that they were linked to the African Shield, and formed part of "Gondwanaland," in Triassic times. This land was broken into fault blocks and much of it sank beneath the sea as witness the anomalous drainage of the Deccan. All the rivers rise high on the west coast and flow to the east. In a short time this state of things must change, owing to capture by the steep western streams. Hence we may deduce the *recent origin* of this very 'insecure' type of topography.

One of the most mobile portions of the crust today lies to the south-east of Asia. It is sketched in Fig. 73 (right). This represents the small coral islands of Tukang Besi (south of Celebes), which are arranged in three rows. The ocean floor is *rising* in the outer rows and accordingly raised coral reefs fringe the little rocky isles. In the central row the floor is *sinking*—and here only ring shaped coral *atolls* are to be seen.

B Climatic Control

The salient feature in the climate of Asia is the large area of the land mass. If we realize that Africa (from a climatic point of view) is hardly separated by the Red Sea, then the centre of the Afro-Asiatic Continent lies in the south west of Asia, not far from the Sea of Aral and Turkestan. This determines two important climatic factors. The first is the locality of the great desert belt, and the second is the position of the low pressure centre in summer (Fig. 58). Owing to the enormous height of the Plateau of Tibet the centre

of Asia is nearly as cold as the Tundra along the Arctic Ocean. This is indicated by the course of the isotherm for 68° F. in July. It forms a remarkable "cold loop" around Tibet, as shown in Fig. 75.

Any country which owes its rainfall largely to winds carrying moisture from the sea exhibits the following characteristics. The rainfall depends on distance from the sea coupled with the elevation of the land. The winds supplying Southern and South-West Asia are

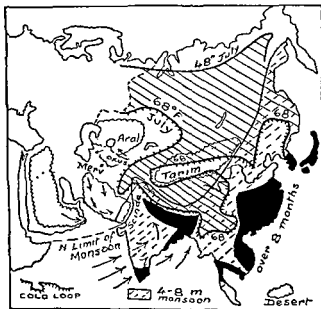


FIGURE 75—Climatic controls in Asia. Note the "Cold Loop" of the 68° July isotherm over Tibet. The region affected by the monsoon rains in the south-east is charted. The four main desert areas are shown by dots.

chiefly the southern monsoon winds, which blow in the warmer months of the year. They are in effect the surface currents of air which supply the place of the air rising at the North Indian low-pressure area. As the air strikes against the great mountain barriers described above, they deflect it up rapidly into cooler layers, and so it is chilled and cannot hold its moisture content. On crossing the ranges (from the south) the air tends to sink on the northern side. Something of a Föhn effect arises, causing a drying wind which parches the plains of Turkestan and Tibet.

The aridity of East Persia and Scinde is not easy to understand at first glance. As Kendrew states: "It is a striking fact that the Thar

Desert [Scinde] lies almost exactly in the centre of lowest pressures [during the monsoons] and the scantiness of its rainfall is a cause for surprise. It is the result of the previous history of the winds that enter it.¹ These are shown in the accompanying figure, where all the winds are seen to be dry, for the south-west winds hardly cross enough sea to gather the necessary moisture. The Gulf of Cambay is practically the northern boundary of the south west monsoon winds of summer. (For rain in Asia, see Fig 58.)

This zone of arid and desert lands extends across Asia from the Sahara to Manchuria. It is not due to the trade winds, for they never reach inland Asia, but to the peculiar topography of Asia. The deserts are in fact "Rain Shadow" deserts, due to the belt of gigantic mountains which cause the inland plateaux and basins to lie in the shadow as far as the rain winds are concerned.

We may turn to Ellsworth Huntington's research² for a graphic account of the climatic changes in the huge arid region, 3,000 miles wide, between the Caucasus and Mongolia. He states that the most widespread proof that there have been climatic changes in Tibet during the last two or three thousand years is found in the death of vegetation over large areas. Ancient routes have been abandoned and no pastoral occupation exists where old records tell us it was once very important. Thirteen rivers running into the Tarim Desert have now ceased to flow long before their valleys reach the ruined Buddhist towns of a thousand years ago. The modern towns are all much higher up the rivers and are much less important than the ancient settlements (see Fig 75).

The history of Lake Lop Nor (which receives the River Tarim) shows that in the first century A.D. the lake was probably seventy miles across. It is now only five or ten. From the third to the sixth century the region was intensely arid and six towns were abandoned. From the ninth to the sixteenth century conditions were better, and towns sprang up, but in the last few centuries and conditions have arisen once more (Fig 76).

Turfan lies 200 miles north, near the Eastern Thian Shan Ranges, and possibly below sea level. It shows the same sequence of events, for in the first century it was densely populated, and again from the ninth to the fifteenth century. In the other periods it was nearly abandoned or settlement greatly decreased.

¹*Climates of the Continents* (Oxford 1923)

²*The Pulse of Asia* (Boston 1907), and later publications

In the southern deserts Huntington shows that the same changes occurred. In Seistan (South West Afghanistan) ruins are incredibly numerous and mighty cities of the dead crowd the desert region. In 325 B C Alexander returned from his invasion of India by way of Persia. His general Krateros led one large army with many elephants through Seistan without any special difficulty. Today, a small caravan of twenty or thirty camels can scarcely find water and forage on the same route. Yet the ruins of strong forts show that this long continued to be an important trade route.

The variations in the Caspian Sea have been studied by many writers. Probably not far back in prehistoric time this sea extended a long way into Russia, and was certainly connected by a gulf to the Aral Sea some 500 miles to the north east⁴. Old strand lines at Baku,

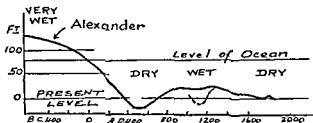


FIGURE 76—Approximate changes in the level of the Caspian Sea which serves as a gigantic rain gauge! (After Huntington)

600 feet above the present level, have a very recent appearance. On the eastern side at Jebel, Huntington has recorded strands at the 230 foot level and at 150 feet. The town of Merv to the east shows vast ruins for which there is not adequate water today (Fig 75).

Before the time of Christ the route from India seems to have led down the Oxus River into the Aral Gulf and so into the Caspian Sea. In A D 500 a wall was built to repel the Huns but it is now partly under the waters of the Caspian, so that the sea was even lower at that date. In A D 900 it was 29 feet higher than now. In 1221 the Oxus River still reached the Caspian by one arm of a bifurcation near Khiva. The other arm still enters the Aral Sea, but the supply to the Caspian ceased about 1550 (see Fig 76).

It is of great interest that when these desert regions were flourishing, Kashmir, to the south, seems to have been so cold and snowy that agriculture was impossible. Its peoples were then nomads who were

⁴Cf the middle map in Fig 98 for other changes.

obliged to drive their flocks southward in winter into the warm plains of India. The general change of wet and dry periods since 300 B. C. is illustrated in the accompanying graph, which shows the fluctuations in the level of the Caspian Sea. (See also Fig 58)

C The Vegetation

While the vegetation agrees in some respects with that of Europe the distribution resembles that of North America (Fig 58). The tundra zone occupies the Arctic lowlands and grades into the Taiga where thin forests of pine border the open tundra and gradually become denser to the south. This pine forest extends to latitude 55°. On the west it gives place to the zones fringing the central deserts. First come the grass-lands, along latitude 50°, then the scrub-lands and in the centre the deserts. The latter extend from Western Manchuria, with intervals, to the Red Sea. The chief deserts are the *Gobi* in Mongolia, the *Tarim* in Turkestan, *Seistan* in Persia, and the Arabian Desert. Due to its great elevation the Tibetan Plateau (12,000 feet) really rises into "Arctic" climates, and in some respects resembles the open tundra. The southern arid margin is another zone of steppes, which merges into forest as the wetter regions of the south and east are approached. (See maps on page 150)

In Manchuria and North China is a cool deciduous forest like that of Europe or South East Canada, with beech, oak, poplar, and willow. Central China had luxuriant forests of bamboo, banyan, camphor tree, etc., which have largely been cleared by man. In the south true tropical trees occur such as mahogany and ebony, and thick jungles alternating with huge swamps are characteristic of the hot wet south east portion of the continent. The seasonal rainfall of India leads to fairly open savannah woods save on the wet south west coast and along the Himalaya Scarp. A Mediterranean flora, due to the wet winters grows in Asia Minor and adjacent countries.

We have now discussed briefly the changing environments in the Old World during the time of man on earth. No one can deny that Asia is the probable cradle land of man, but few writers have tried to envisage how the changing environment probably affected primitive man.

In Asia the climatic stimulus is greatest today as it was in the past. In a large part of Central Asia, the range of temperatures between January and July is over 50° F. This is the reverse condition from the tropics where there is little change from day to day and

month to month. There is not much reason for progress in such a stable environment as the tropics, and accordingly in Fig. 77 I have labelled it "Zone of Stagnation." On the other hand, in Arctic lands the stimulus of a *variable* climate is present, but conditions are too hard for real human progress to be made. This is the "Zone of Privation." Between the two zones is the "Region of Stimulus," which, for primitive man, would probably be in the wood-lands bordering the steppes



FIGURE 77—A generalized map showing the various environmental factors which have determined racial migrations from Central Asia. The arrows show where the successive waves moved along the main corridors.

In the north of Asia there is abundant evidence of ice-caps much as in Europe, but the ice-cap was not so thick nor so universal. Fluctuations of climate would drive folk southward; to Africa and India first, since they are easiest to reach; later to Europe and Australia, and last to America. The sequel will show that this is precisely the order in which the racial migrations left Asia.

Primitive tribes would manage to traverse difficult country such as the "land-gap" of the Khyber Pass or the "water-gap" of the East Indies, owing to tribal pressure from the northward. Obviously, there would be no such urge making them *return*, since the southern lands were relatively empty. Hence I have labelled these gaps as *Land-Valves* and *Water-Valves* in Fig. 77. (For crops and minerals of Asia, see page 229)

CHAPTER XVI

THE RACES OF SOUTHERN ASIA

A *Objections to Mongolian as a Race Name*

The most popular classification of races as regards Eurasia seems to be indicated by the heavy line running from Lapland to Burmah shown in the top left map in Fig 78. The writer cannot understand how this division between the so-called *Caucasian* and the so-called *Mongolian* has persisted so long, presumably from the time of Cuvier in 1820. Many authors (e.g. Ripley) object strongly to the term *Caucasian* and to the writer the only common character of the nations living in the so-called *Caucasian* moiety of Eurasia is that they nearly all speak Indo-Aryan tongues. But this use of *language* as a primary guide to race has long been given up everywhere. The present writer objects just as strongly to the use of the term *Mongolian Race* for reasons which follow.

Let us however use as many traits as possible as Kroeber advises us¹. In Fig 78 I show the main features as given in Biasutti's atlas of anthropological criteria². If we consider skin colour we find that the isopleths of colour have nothing in common with the reputed major racial division (shown by the heavy line). The olive complexion is equally common on both sides, as also is the next grade of colour, light brown. Head index may be considered next, and here again the isopleths clearly run at right angles to the reputed race boundary— which to the ecologist means that they have little or nothing in common. Consider facial breadth (in the third map) and we see that broad faces are characteristic of the Eurasian peoples as a whole— there is no division here either along the reputed boundary. So also stature gives us no data to support this division, and nasal index has little bearing on it, since Biasutti labels all the Eurasian region (except the south-east) as leptorhine. Only in Biasutti's map of hair texture is there some justification for this division, for the straight haired folks are in general to the east of the reputed boundary and the wavy haired to the west (see the map of nasal index). Kroeber however assigns all the straight haired peoples of Central Asia to the *Caucasian*

¹In his *Anthropology* (London 1935)

²*Antropogeografia Generale* (Memorie Geografiche Supplemento alla Rivista geografica italiana Florence 1912)

while Ripley links Alpines and Mongols in his chart of hair distribution. Minor differences like shovel teeth and the epicanthic folds are surely not important enough to isolate the Mongols as a major race.

The last map in the series shows us that racial history lends little support to these Caucasian or Mongol subdivisions. Right through historic times peoples and cultures have passed freely between the

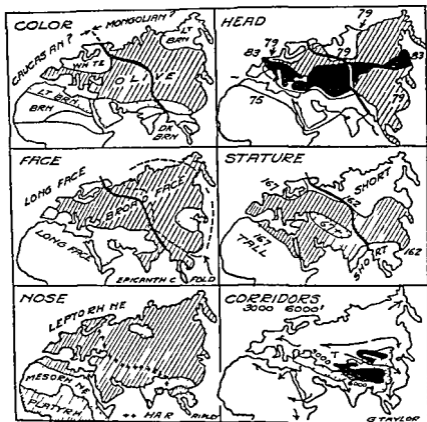


FIGURE 78—Maps charting the distribution of colour, head index, face index, stature and nasal index. No support for the division of the peoples of Eurasia into Caucasian and Mongolian can be derived from these maps which are taken from Biasutti or Ripley. Note also that the corridors of migration cross the so-called division.

east and west of Central Asia as shown by the two long arrows. We may be sure that in prehistoric times—especially in the very long interglacial period when the climates were neither so dry in summer nor so cold in winter—primitive peoples migrated even more freely

between the Turkestan area (*T* in the map of corridors) and the regions east and west of it

Early Chinese history is an account of thrusts from the north west. Indian history is the same story of thrusts from the north west. Egyptian history records the major migrations as coming from the north-east. European history is entirely controlled by thrusts from the east. There can be little doubt that stresses and strains in the heart of Eurasia—one deduces in the area between the Caspian and the Pamirs—have set in movement racial migrations throughout the ages. If this be so, then the main racial isopleths should be lines more or less *concentric* around the centre of disturbance—and cannot possibly run through the Himalayas as shown by the heavy line in the map of skin colour.

For these reasons the present writer in 1919 adopted the term Alpine Mongolian to indicate that the Mongol type was only a variant of the fairly homogeneous group of peoples which occupy the main bulk of Eurasia. The characters of the Alpines are indeed summed up in the set of five charts. They are all brakeph (index 80 to 90), almost all olive in colour, all broad faced of medium stature, and with leptorhine noses. The hair is on the whole wavy in the west and straight in the east, but is never curly—much less frizzy. They occupy the centre of the series of approximately concentric racial zones—and for reasons already given represent the latest development of the human race. Man has evolved in the common cradle land of most of the mammals—the heart of Eurasia—owing to the fact that the climatic stimulus right through later Tertiary times has been the most favourable for producing mammalian evolution. As I have stated earlier the cradle land of the higher mammals would *a priori* be the most likely place for the highest type of all (man) to originate and to *continue evolving*.

The central regions of the Old World are found to be typically the home of brakeph peoples. These extend to the northern, eastern, and western margins. There are dokeph peoples in Tibet, sporadically in China and in the south there is a rim of dokeph peoples in Mesopotamia and India while along the Yenesei in the north, and on the festoon islands and ridges of Japan and Kamchatka there are also rather mixed dokeph peoples (see Fig 44).

To the student who has carefully followed the preceding 'distribution' evidence, the profound significance of the fact that brakeph skulls occur throughout the area at the 'centre of evolution' will be

apparent (see pp. 268 to 272). It indicates that the broad-headed stocks are a later product of evolution than the narrow-heads.³

Using the usual language subdivisions, we find that brackish Eurasia is divided into three almost equal areas (see Fig. 70). In the west is the Aryan "aggregate," in the north is the Altaic "aggregate," and in the south-east is the Tibeto-Chinese or Sinitic "aggregate." Thus the most primitive Aryan peoples are probably to be found in the West European "wedge," the most primitive Altaic tribes proba-



FIGURE 79.—Distribution of the "Mongolian Fold" (see *a*) Sections of the fold and of the normal eyelid at *b* and *c* (After Biasutti)

bly in the Finn and Yakut wedges, while the most primitive Chino-Tibetan group is likely to be found amid some of the mountain clans in the Shan States or thereabouts.

In this continent, as elsewhere, the languages in the *inner* portion of their respective areas are probably spoken by the races among whom such speeches were evolved. But on the *margins* we may suppose that the later language has generally overlapped the proper ethnical boundaries. This has certainly happened in Europe, India, and China, and presumably on the northern margins also.

³This thesis was first elaborated, I believe, in my paper on "Climatic Cycles and Evolution," 1919, *op cit*

One characteristic of two of these great Asiatic aggregates is the *epicanthic fold* (Fig 79) This is a curious doubling of the upper eyelid whereby a fold of skin is drawn across the inner corner of the eye in a more or less complete manner The distribution has been plotted by Biasutti and is given in the adjacent map It is most pronounced in the Tungus Manchu region of East Asia where a very large proportion of the inhabitants exhibit it In Northern Siberia China and Japan about two thirds of the people show this feature In Borneo Burmah Turkestan and the coasts of Bering Straits (on both sides) it varies from 60 to 30 per cent It is found among the Eskimo in the same proportion It occurs only sporadically in Western Siberia and in America and Polynesia It seems to the writer to be one of those readily apparent but insignificant facial differences which have caused ethnologists to segregate the Eastern peoples and so to lose sight of their biological affinities with the Alpines of Europe and America

A false epicanthic fold is found among the Bushmen and Hottentots of South Africa In both cases it may be due to the great development of the cheekbones—which perhaps leads to a stretching of the skin of the eyelid—but I have seen no satisfactory explanation of this curious feature

We may sum up the races of Asia by saying that they are essentially the same as those already discussed in Europe and Africa The northern races of Asia are Alpine and Nordic as in Europe The southern races are Mediterranean Negro and Negrito as in Africa The chief difference is in the belt of *Australoids* in India for which there is no living analogy in Eur Africa (Possibly the Ushtettas of Algeria have Australoid blood) That variety of Alpine known as *Paraean* is also rather unlike any Western group

B The Negratoes

After this introduction dealing with the major racial groups of Asia we may study in more detail the various peoples beginning as heretofore on the margins It is in the tropical jungles and distant islands that we should expect to find the most primitive living races not because they originated here but because they were driven here by past climatic changes and migrations remained here and *stagnated here*

The evolution of man seems to proceed extremely slowly in the easy conditions of the tropics with its readily collected fruits and its

unfavourable heat, humidity, and tropical diseases. It is often assumed that because *Pithecanthropus* was found in Java, therefore man developed from the ape in this region. But Matthew's study of the higher mammals (which is explained later) is opposed to this theory as indeed is the whole evidence of racial evolution and distribution.

The most primitive folk in Asia are probably the Kadars of the tip of India, the Semang of Perak, the Mincopies of the Andaman Islands, and the Aeta of Luzon in the Philippines. They are Negrito people whose characteristic features have been described earlier (p 91). This Negrito "stratum" is represented by "inliers" throughout the south east littoral of Asia and in the adjacent islands (see Fig 36). They are brachepic peoples who seem to be in general surrounded by dolichopithecoid tribes, and they do not seem to have any obvious relation to the great Alpine Mongolian aggregates of Asia. Dixon (1923) attempts to unite the brachepic Negritos with the early Alpine peoples (whom he calls Palaeo Alpine). They have similar horizontal head indexes, which is a basis for argument, but in almost all other particulars, e.g., hair, skin colour, stature, nasal index, and zonal and strata distribution, they are far apart. In my opinion the theory of a separate primitive stock seems to be the best explanation of their origin, but the problem is difficult and must be left to the future.

Type	Race	Locality	No	Head index	Nasal index	Stature
I	Mincopi	Andaman	100	82	90	1 484
	Aeta	Luzon		81.5	95-106	1 460-1 500*
				83.5	101.9	1 461
II	Semang	Perak	20	77.7	97.1	1 507
	Sakai	Sumatra	19	76		1 562
		Perak	28	79	86	1 490
	Toala	Celebes	23	82.2		1 573
	Veddah	Ceylon	55	75.1	84	1 571
III	Dravidians	South-east India	6 528	70.2	82.4	1 623
	Munda	South west Bengal	100	74.5	89.9	1 589
IV	Ainu	North Japan	55		3.4 (55)	1 579 (213)
V	Toda	South India	70	76.5		1 581
			115	73	76	1 680

*Where two figures are given they represent extreme range of tribal means

The foregoing table, based on Giuffrida-Ruggeri,⁴ gives the anthropometric data of these Negritoes and of other primitive Asiatic Negroids.

As we shall see, there is a submerged stratum of Negrito peoples allied to the above certainly in south-eastern and possibly throughout Southern Asia, e g , in Persia and Arabia, and possibly in Japan.

C. The Peoples of India

In many ways India is of particular interest to the student of racial distribution. It is close to the probable centre of human evolution;

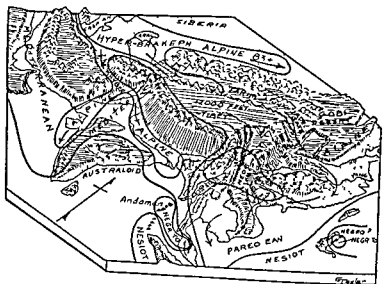


FIGURE 80 —Block-diagram of Southern Asia to show how topography controls human migrations. The centre of the racial zones is near the Caspian Sea with Alpine types. Parao-ean (Malay variety of Alpine), Mediterranean, Australoid Negro, and Negrito are successively more marginal. Note the Jade Gate and the Khyber Pass. (From *Ecology*, July, 1934)

and yet the whole range of man's development is represented in this southern peninsula, shut off on all sides by the sea or by very high ranges and plateaux. The main entry of recent migrations has been from the north west. The relation of the racial zones to the topography is illustrated in Fig 80

⁴*Outlines of the Anthropology of Asia* (Calcutta, 1921), translated by Chakladar

Mitra in his book *Prehistoric India*⁵ shows that all the early cultures are preserved in India. These are summarized in the following table, in which the oldest strata are at the foot

	<i>Culture</i>	<i>Locality</i>
10	Dolmens of Madras	Madras
9	Indo-Sumerian (and Kurumba?)	Mohenjo-daro (Indus)
8	Early Iron Age and Pre Dravidian	Throughout south
7	Negrito paintings	Raigarh (west of Calcutta)
6	Early Mousterian	Kaira Upper Krishna
5	Acheulian relics	Godaveri River
4	Proto-Veddah skulls	Adichallunur (south)
3	Pre Chellean relics	Narbada River
2	Pliocene relics	Dodaveri River
1	Miocene flint flakes	Burmah

The racial "isopleths" (contours) are naturally crowded together in India, and racial mixture is probably universal. But by reference to bordering regions where the zones are broader and not so "ragged" it is possible to trace out the migration zones in India with some success.

The most primitive peoples are the Mincopies of the Andamans already mentioned. Recent ethnic surveys have revealed the survival of a group of dwarf folk in the rugged hills in the extreme south of India. These Kadar people are akin to the Mincopi. Next come the Veddahs, just where one would expect them in the tropical jungles of the Island of Ceylon. Their measurements are given in the preceding table. About 4 000 of them were reported in 1901, who lived mainly in the centre and south east of the island. As mentioned earlier, they are fairly closely allied to the Australian aborigines.

Ruggeri mentions four skulls from the vicinity of Madras with a head index below 60'. Thurston describes them as prognathous and with the receding forehead of the Negro rather than of the Veddah. These skulls are of considerable interest in connexion with the affinities of the Lower Melanesian Negro with the African Negro for not many links are known in the wide extent separating the two groups.

Many other fragments of tribes in India are allied to the Veddahs, such as the Santals, Mundas, Kols, etc., all of whom have similar characters to those of the Veddah in the table. They have all been classed as *Pre Dravidians* (i.e. Australoids).

⁵Calcutta 1927

The Veddah Australoids were apparently followed into India by the *Dravidian* peoples who are found in the purest form perhaps in the Southern Indian jungles. Of these are the Kota, Badaga, and Kurumba peoples of the Nilgiri Mountains of Southern India. They have almost leptorhine noses (index 75), and are somewhat taller than most of the so called Dravidians with a nasal index from 84 to 94.

It seems probable, as Ruggeri suggests, that the Dravidian language was imposed on aboriginal Veddah types by relatively few invaders of the Kurumba type. These latter were in many ways akin to the Ethiopians of Eastern Africa. It seems likely that the remarkable cultures recently discovered along the Indus at Mohenjo-Daro Harappa, etc., were developed about 3000 B.C. by peoples belonging to this Ethiopian (or Mediterranean) race, akin to the Kurumbas of today. These cities were in communication with Sumeria, and in many of its phases their culture excelled the contemporary Egyptian civilization. The Mohenjo script has not yet been deciphered, but it is said to be very like that discovered in Easter Island some 12 000 miles to the south east! If this be proved, here is a striking example of the kinship of fossil and migrant languages (p. 191).

The Aryan speakers in their invasions about 2000 B.C., were mostly opposed by primitive Veddah Australoid tribes (or *Dasyus*) with low stature, dark skin, and broad noses. The Bhils and Gonds, in or near the Vindhya hills, who bore the brunt of the Aryan attacks, have just these features. Some of these tribes in Chota-Nagpur still speak the primitive Munda Kol languages, though the great bulk of the Lower Indian races speak higher languages like Tamil or Telugu of Dravidian type. On the other hand the Bhils have learnt an Indo Aryan tongue. A very interesting tribe is the Toda people of the Nilgiri hills. They are characterized by their hairy appearance, thus resembling the Ainu and the Australian. Indeed, they may be akin to an early form of the Nordic race.

The north of India has been invaded by light coloured *dokeph* peoples fairly closely akin to many in Western Europe. Many Persians and Kurds have these features also, which may be traced from India to the British Isles. The 'ethnographs' of the Persian and English are almost identical. There is also a group of *brakeph* light-coloured peoples who are identical with the Alpine peoples of Europe. Galchas, Tajiks, and Armenians link these to the Europeans.

It seems clear that the ancestors of these Aryan folk came to India from the Bokhara region *via* Persia. They are concentrated chiefly

in Punjab, Rajputana, and Bihar. In these regions there are only about 2 per cent broad- and 73 per cent narrow heads. In Eastern Bengal, however, the Brahman folk with Aryan speech show 35 per cent broad heads. These latter are assumed by Risley to have much Mongol (i.e., Eastern) blood, but Chanda⁸ thinks that they are really derived from Pamir (i.e., Western) Alpines. There is no linguistic

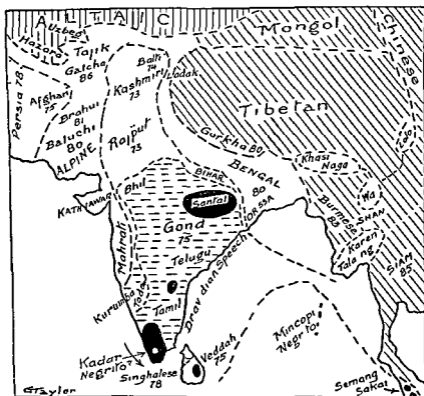


FIGURE 81—Races of India (Based on Ruggert) Figures refer to head indices

evidence in Bengal of a Mongol invasion, whereas it is highly probable that their broad head character is due to an invasion by Pamir Alpines through the low pass south of Merv. This would be of the same type as so often invaded Europe in Neolithic times. This interesting association of dokeph and brakeph tribes resembles that of the races in Northern Europe in Neolithic times when the Nordic races were developing (see p. 165)

⁸In his book *Indo-Aryan Races* (London 1916)

ARYAN SPEAKERS OF ASIA

(After Ruggeri)

Type	Race	Cephalic index	Stature	Nasal index
General type	A Indo-Afghan (Nord c?)	74	1 645	69
	B Indo-Persian (Alpine)	81	1 663	71
	C Mediterranean	78	1 680	66
	D Armenian (Alpine)	87	1 680	67
	E Georgian	83	1 650	60
Local types of	A Rajput of Bhar	72		72
	A Sikh (Punjab)	73	1 709	69
	A Balti (near Western Tibet)	75	1 617	68
	B Brahman (Bengal)	80+		
	B Mahrati (Western India)	80	1 613	75
	B Brahu (Baluch)	82	1 659	71
	D Galcha	86	1 669	67

Chanda believes that when this Alpine migration (B above) arrived in India they found the middle Gangetic Plain in possession of the dokeph Aryans (A above). They therefore passed by and reached Orissa in the east and Kathiawar and the Deccan in the west (see the zones in Fig 81)

D Races of South West Asia

We find much the same order in the zones of folk in Arabia Mesopotamia Persia and Turkestan. All round the borders of the Indian Ocean there seem to be relics of a Negroid or Negrito stratum. Husing (1916) suggests a race of Negritoes as the most ancient population of the coasts between India and the Persian Gulf. He thinks that elements of a Dravidian population are found in the interior of Persia. Dieulafoy found Negrito or Negro people near Susa in South West Persia. While no Negroes survive in Syria there are many skulls (allied to Neanderthal) being found in the caves hereabouts which may well indicate the presence of an early Negroid zone. Ruggeri suggests that the brakeph Arabs of Yemen (C I 83) differ from the Arabs of Muscat (C I 78) owing to some of this Negrito blood which is also shown by their lower stature and curly hair.

The next zone is the Mediterranean which is characterized by Semitic languages constructed on a plan entirely different from the Aryan but not so remote from the Hamitic tongues of North Africa. Semitic consists essentially of trilateral words such as *falat* (bend)

which are changed internally, e g , *filat*, *fulatu*, etc , much as we add inflexions Somewhat similar methods are employed in Efate (Melanesia) and Tagala (Philippines) according to Macdonald,⁷ and possibly these belong to the same linguistic migration zone Many of the Arab peoples are probably ethnically akin to the Galla and Ethiopians on the west and to the Dravidians proper (Badaga etc) of India on the east

The Jews of Syria are a special development of the Semitic group Their facial characters, i e , large nose, protruding lips and eyes, may be in part due to a more or less unconscious tendency of a "peculiar people" to perpetuate types in which the race facies is marked (We see perhaps the same tendency in the Basques Again, no doubt golden hair, blue eyes, and a fair skin were unusually popular among the youth of the Nordic race, and so tended to be perpetuated for similar reasons) There is, of course, little ethnic relationship between the original Semitic Jews of Syria and the Russian Jew of Poland and the vicinity In my recent book *Environment and Nation* I discuss the view that the Polish Jew is largely descended from the Khazars or Royal Scythians, who were keen traders in the Ukraine from A D 500 to 900 These latter were, of course, Alpines, and racially quite distinct from the "Mediterranean" Jews of Syria and Spain It is interesting that the modern Polish Jew calls himself "Ashkenazim," i e , Scythian

A great racial boundary runs along the scarp bounding the southern edge of the Anatolian and Persian Plateaux To the south the languages are Semitic (Hebrew, Aramaic, Arab, etc) and the people are all Mediterranean in race On the highlands the people are mainly Alpine (though some few may be Nordic) and the languages are Aryan The writer believes that civilization itself developed north of this scarp and spread from north to south far back in prehistoric times Hence he feels that the most interesting archeological region in the world lies east of the Caspian Is it only a coincidence that almost the earliest great religion that of Zoroaster, developed here, a thousand years before that of Christ?

A very interesting region of mountain-lands extends from the Black Sea to the Tibetan Plateau It forms the border of the two great cultural aggregates the Aryan and Altai Through the centuries these two groups, debarred by totally different languages

⁷*The Oceanic Languages* (London 1907)

and cultures from sympathetic comprehension of each other, have been warring, raiding, and destroying. Thus has arisen what I have termed a 'shatter belt' of broken tribes, who have retreated into the Caucasus Mountains and there resisted the racial amalgamation which is the lot of the agriculturist, and to a less degree of the pastoralist of the plains.

The groups in the Caucasus and thereabouts comprise many peoples and many tongues. Only the language of the Ossetes of the central northern slopes approaches at all closely to the Aryan. They are not far from the Russians in race and language. Close to the Black Sea are the Kabards and Abkasians, who speak a curious agglutinative speech. Its nearest allies are in far off North America, though Basque is slightly akin in structure. The suggestion that these Caucasus people might be related to the North Amerinds was once scouted as impossible, but the present writer sees no inherent difficulty. Their zonal position to the west of the centre of dispersion agrees well enough with that of the Amerinds far to the east in Canada. It may be noted that Roland Dixon finds the same type of skull in these two regions, which corroborates my suggestion of 1921.

Space does not permit of reference to all the other interesting peoples hereabouts. The Armenians seem to be an Alpine people characterized by a specially flat occiput. They are doubtfully allied with the ancient Hittites. Passing to the slopes of the mountain ridges leading up to the Pamirs we find other Alpine peoples so like those described from Savoy in France that they are termed 'Belated Savoyards'. They have in effect lagged behind (as 'inliers') in the march to the west. Among these are the Galchas of the Hindu Kush. In the north east of Persia and in Turkestan blond features are quite common. Among the Tajiks of Samarkand, says Ujfalvy,³ 38 per cent have blond beards. Chestnut hair is very common in Persia, as it is among the West European Alpines. The skull measurements are identical and, indeed, among these Alpine peoples we have, I think, types of the latest evolved races in the world.

We must note that in Turkestan Sergi states that a stratum of dokeph skulls with non Mongoloid features was found in the excavations. Tavorshi also found a similar type among the modern Turkomans. They have been described by Haddon as "Proto Nordics". No doubt they are close to Dixon's "Caspians".

³*Explorations of Turkestan* (Paris 1896)

The chief interest to the student, however, in these regions of Persia and Turkestan is that what seems to be the earliest history of civilization has been investigated here

At Askabad (near Merv) Pumpelly⁹ found the following strata

<i>Top</i>	14 feet with Iron Age relics
	15 ' Copper (and lead) relics
	70 ' Wheel pottery
<i>Bottom</i>	45 ' Hand made pottery

It is difficult to date these very deep lowest strata, but they are probably older than similar culture layers in Mesopotamia or Egypt

At Susa (150 miles north of Basra) 26 feet of upper debris is said to represent the interval since 4500 B C Yet below this is another 50 feet of debris, which reaches back to an estimated date of 12,000 B C At first wheel made pottery is found then rough, thick pots lie below this, and finally, in the oldest layers, are crude cuneiform designs

On the ever-growing delta of the Euphrates a Sumerian civilization grew up, much earlier than that in Egypt, possibly when the sea reached inland to Eridu about 6000 B C To the east is Susa, and still farther to the east an Indo Sumerian civilization has recently been discovered in Scinde and Punjab (p 214) Hence Egypt, instead of being the major cradle of culture, as some believe, is merely an outlying south western colony of Asiatic civilization

The Site of the Earliest Civilization

The suggestions of the writer some thirty years ago on this topic are corroborated in the latest text on changing climate in the Ice Ages, *Glacial Geology*, by R F Flint (New York, 1947) Flint writes

From excavations at the buried former city of Askabad Pumpelly concluded that the city grew up about 8000 B C, and that cereal crops were then cultivated in the surrounding region At that period both the Sahara and the trans Caspian region enjoyed a climate somewhat like that of Central Europe today because the reduced ice sheet still lay over Fennoscandia and the belt of cyclonic storms lay well south of its present position Both regions later, apparently at the time of the Optimum became too dry for agriculture and Askabad as well as the Saharan communities fell into ruin The first great urban communities were established while the region of greatest modern industrial progress was still partly covered by the Scandinavian Ice Sheet

⁹R Pumpelly and others, *Explorations in Turkestan* (Washington, 1905)

CHAPTER XVII

THE RACES OF EASTERN ASIA

Topographic control of racial migrations into South East Asia is as marked as into India. This is illustrated in Fig 80, where we see the two main land-corridors emphasized. These are the "Khyber Gate" into India and the "Jade Gate" into China. Between is that extremely rugged portion of the "Young Mountains" which extends from Tibet to the East Indies. Even today we have no detailed maps of portions of this area, where the Salween, Irawadi, and adjacent rivers flow in parallel valleys. It is this series of insurmountable ranges which has prevented any real mixing between Indian and Chinese cultures.



FIGURE 82—Racial origins and migrations in Eastern Asia. Early centres of Chinese culture are shown by dates

The race zones off China show Negritoes surviving in the Philippine Islands (Fig 82). Sometimes Negroes are doubtfully reported from this area also. There are many relics of a Nesiote (Mediterranean) Zone. But the dominant race is the *Parao-ean*,¹ the rather small slight Alpine type, with marked cheek bones and a flattish nose, to which the Malays and peoples of South China and much of Japan belong. In the rugged mountains are many survivors of Mediterranean tribes (such as the Lolo). In the north, nearest the point of entry, are the latest types. These are the tall Northern Chinese, Koreans etc., many of whom approach fairly closely to the European type of the Alpine race.

¹This is a Greek term meaning 'from beside the East' used by Haddon for these marginal Alpines.

A Japanese Race Origins

One of the most remarkable chapters in the history of national evolution is that dealing with Japan in the last seventy years. The ports were only opened to foreign trade in 1860, and yet in this short period Japan has advanced from an isolated medieval empire into the leading manufacturing nation and most formidable military power in the Pacific. That this is due in no small degree to the environment of Japan and to the races which inhabit it, no one will deny. The population of Japan is about seventy millions, and its density is surpassed only by that of Belgium and Holland.

Dr. Munro gives the following account of the chief racial stocks in his book *Prehistoric Japan*.² There seem to have been at least two primitive races in Japan. The chief were the *Ainu*, who for many years resisted the Japanese invaders throughout the southern islands. They slowly retreated, during the first ten centuries of our era, to the north (Fig. 82). They are now found only in Yezo (10,000) and Sakhalin (2,000). Their head index is about 77, and they are a short people (1,579 mm). The skin is fairer than that of the average Japanese, but the chief feature is the tremendous development of hair on head, face and body. The eyes are wide set and brown (occasionally hazel) in colour. The *Ainu* have legends of "Pit-Dwellers" in the country before them, but most authorities think that these were akin to the *Ainu*, though Tsuboi refers them to the Eskimo, or their allies.

The dominant Japanese stock seems to have entered from Korea in various migrations of tribes classed as *Yamato*. They were acquainted with iron, and made use of the wheel for pottery. For a time they used dolmens and caves for the dead, and their entry was not long after the Bronze Age. The main influx of this taller "Alpine" or Manchu type was probably between 1000 and 500 B.C., though Bishop makes their entry some five hundred years later. Munro inclines to the belief that much of their culture (like that of the Chinese) came ultimately from Sumeria or Akkadia or thereabouts (Fig. 80).

The other great invasions seem to have come from the south, and consisted of shorter *Paraeocan* races akin to the Malays. Munro refers to them as *Kumaso*. Bishop thinks they migrated from the

²Yokohama 1911

Yangtse Delta, then held by Indonesians, and much recent work is inclined to associate these stocks rather with those of Southern China than Malaya. They were a well knit sturdy group, with broad chests and long bodies. They form perhaps the most abundant stock in Japan today. Munro suggests however, that there was possibly a *Negrito* stock in South Japan in the early days, from whom some of the Kumaso folk may have been derived by race mixture with higher types. Munro is confident that the Japanese aristocracy was partly of "Caucasic" or Iranian stock, and concludes that the "Japanese are not a race but a loose mixture of variously assorted racial features, which in times past have found their way to this 'Ultima Thule' of Asia."

Matsumura's recent work on head shape and stature in Japan shows that relatively *tall* broad headed folk (Alpine?) occupy the north-centre and west of Hondo. The long heads (Caspian or Mediterranean?) live around the Inland Sea, and on the actual west and north east coasts of Hondo. The *short* broad heads (with some *Negrito* blood?) live in small groups in the extreme south of Kiushiu, and in the extreme south and west of Hondo.¹

There is seen to be an interesting parallel between Britain and Japan as regards race as well as environment. In Britain a Mediterranean stock was invaded and driven away by Nordic tribes. In Japan the Ainu (akin to Nordic) were invaded and driven away by Alpine (and Paraeocean) tribes. Surely in view of the considerable racial mixture which has produced two of the most enterprising nations of our times, it is folly to quote that dictum as to the "vices of half castes" which we still hear on all sides!

B Races in China

In many respects the Chinese are worthy of the highest respect of the student of races. The same racial type appears in northern chalcolithic deposits and Chinese culture has been virtually continuous, in fact since the dawn of history. With each century more and more of the surrounding tribes have become amalgamated with it and it is for this reason that it is the great rival of white dominance. The Empires of Elam, Egypt, Babylon, Persia, Macedon, and Rome have waxed and waned, and their peoples have become scattered and almost negligible, yet the 400 millions of China still remain

¹See *Anthropology* (Tokyo 1925)

united in culture and ready for the awakening that is coming. This is due in part to their environment remaining much more favourable than that of many of the other empires.

At almost any period anterior to the last hundred years the Chinese held a worthy place among the nations, so that none should blame them if they condemn the arrogance of the upstart nations of today.

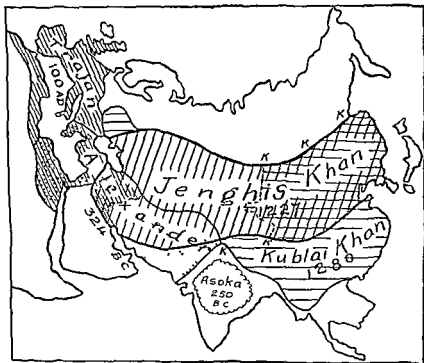


FIGURE 83—Mongol, Greek, and Roman Empires charted to show the vastly greater extent of the former. *K K K* shows the north-west limits of the Empire of Kublai Khan.

The enormous power wielded by the peoples of North China and Mongolia during the Middle Ages is seen at a glance in Fig. 83. Here we can compare the extensive areas of the Empires of Jenghis Khan and Kublai Khan with those of Alexander or of Rome at its zenith. The philosophy, methods of agriculture, industry, and honesty of the Chinese⁴ are only lately receiving the serious attention which Western nations should give to them.

⁴See F H King, *Farmers for Forty Centuries* (London, 1927), and B A W Russell, *Problem of China* (New York, 1922)

Their empire is so huge and populous that we must first ascertain where the typical Chinese folk dwell. Their earliest legends indicate that they came east from the Tarim Basin about 3000 B.C. Even before this date they had written characters which had superseded knotted cords (like the quipu of the Incas) for the purpose of keeping records. The matriarchate had died out, marriage was properly instituted, and musical instruments were invented. Much higher culture than this is connoted by the study of astronomy and the weaving of silk.

About 2600 B.C. they migrated through the "Jade Gate" into the Upper Hwang Ho Basin, and for 2,000 years their capital was in Shen-si (Fig. 82). There are in existence bronze bowls dating from about 2000 B.C., and a large number of beautiful works of art in jade date back to 1000 B.C. Their culture seems to have equalled that of any occidental empire. About 800 B.C. they invented phonetic writing, and about 550 B.C. lived two of the world's greatest teachers, Confucius and Lao-tse, while Mencius lived two hundred years later. The Great Wall was built before 200 B.C.

About 120 B.C. their empire extended to Yunnan. In A.D. 30 the capital was moved eastward to Honan, and other cities, including Sian fu and Kai fong fu, were capitals while China was growing. Although a town on the site of the modern Peking was the capital of the Kin dynasty, the city was not finally established till 1264, when Kublai Khan, Jenghis Khan's grandson, made it his metropolitan city. It remained the capital until 1928. Marco Polo's record deals with the Mongol period, when the Mongols and Chinese conquered half the known world (Fig. 83).

We have seen that the earliest civilization may well have been developed by broad heads akin to the Chinese in Turkestan or thereabouts. This is almost the only region in Central Asia which has not been ruined by desiccation during the last few millennia, and presumably it was also the richest land in the happier days of the past (see T in corridor map, Fig. 78).

We find a common tradition among the Chinese and the Akkadians (The latter were the successors of the Sumerians, who were almost certainly linked with the early Turkestan settlers, and physically were Alpine Armenoids). Thus the Babylonian priest, Berosus (third century before Christ), describes the earliest dynasty as consisting of ten kings and enduring for 432,000 years. This is exactly the same legend as in the Chinese story. The Sumerian art, town life, and

religious ideas are also said by Lacouperie to be closely akin to those of the Chinese

As the Chinese advanced into the fertile lands they hold today, they certainly found the latter occupied by races of non Mongolian stock, akin to the Indonesians and Polynesians, although T'ing is inclined to ally them with the Mediterraneans. There are many relics of such peoples in China today, some of which have not yet fully recognized Chinese rule. They have been enumerated by von Brandt. Thus we find the Lolo in the great south bend of the Yangtse, the Miao in the mountains to the south east of this bend, who number fifty tribes. Some of these are said to have migrated to Formosa in the thirteenth century. In the two southern provinces are the Hakka who come from the north. The Hoklo have been driven to the south east coast, and number two million. In Burmah are the Lishau tribes, akin to the Lolo (see Fig 80). The Ikiia are somewhat allied to the Shans and live in the Sikiang Basin. The Yao are found in Kwang si, Kwang tung, and Hunan, while the Li live in Hainan island. The Moso live on the borders of Tibet and Yunnan in the deep valleys, while the Minchia, akin to the Miao, are abundant in Yunnan.

The relations of the folk in the south east of Asia can be studied along the lines suggested by H. R. Davies in his valuable book on *Yunnan*⁵. He divides the tribes hereabouts linguistically into four main groups which are summarized in the following table.

TABLE OF SINITIC LANGUAGES

I	Mon Khmer Family	(a) Miao (b) Minchia (c) Wa and Palaung
II	Shan Family	(a) Shan (b) Siamese
III	Chinese Family	(a) Mandarin (b) Many local dialects
IV	Tibeto Burman Family	(a) Tibetan (b) Hsi fan (c) Lolo (d) Burmese (e) Kachin

⁵Cambridge, 1909

These classes are, of course, by no means the same as the anthropometric classes, which we hope will some day be elucidated in this very mixed Asiatic area, but they are a step in the right direction. All the above Sinitic languages are monosyllabic, and the words are not inflected, but it is clear that the words have been shortened by a process of phonetic evolution. Words that originally began or ended with two or three consonants together have been whittled down to words of two or three letters. Thus *Brgyad*, as written in the old Tibetan is now pronounced *Gye*, *Lchags* in the old writing has turned into *Chag* or *Cha*. In Chinese the modern Mandarin dialect has lost the final K, T, and P, which are still retained in the older spoken languages. (The same thing has happened to the final GH in English as spoken and to the T and P in northern French.)

Professor Lacouperie contends with great reason that all these languages were once polysyllabic, and there has been a very suggestive difference in the rate of "decay" (or evolution) of the words. Thus in (old) written Tibetan and in some of the Lolo dialects words beginning with two or three consonants are fairly common. In spoken Burmese and Siamese they are comparatively rare, while in Shan and Chinese they have disappeared altogether. If we glance at the migration zones we see that the more primitive peoples (Tibetan and Lolo) have the complex words, and the more advanced (Chinese) has the simpler, more 'economic' method of speech.

When we return to the anthropometric data we find that the historical record is the key to the racial distribution. The head index of China east of the great plateau is 80 or 81. But these lower lands can be divided approximately into halves by a line from the upper Hwang Ho to Formosa. To the north lies the region inhabited by Alpines (81) with moderately narrow noses (leptorhine), with rather long faces with straight hair, and with light brown or olive complexion. To the south of the line are found peoples who become more platyrhine (broad nose) as we move into the Burmese hills, and less platyrhine to the north-east where the nose is almost European. To the south west they also become a darker brown and the hair becomes more wavy while the stature is much lower (Fig. 78).

The ethnological history, therefore, would appear to be that of the other marginal portions of the Old World. We find that a region once settled by dark, short, platyrhine, wavy haired tribes (possibly with a distinct Australoid tendency) is invaded by taller, fairer Alpine peoples who have entered from the north west, round the margin of the great

Tibetan Plateau The racial function of the huge and prolific Chinese population is (in the words of a Chinese writer) gradually to absorb all the peoples which it impinges upon, or which may for a time conquer it This has happened in the south of China It has happened to a less extent with the Manchus in the north, and with the Yunnan tribes in the south west It is beginning in the Malay States and in the East Indies

This slow incorporation may become the chief racial phenomenon in all the lands bordering the Western Pacific in the future We find that the same thing has happened in Central Europe, where the allied broad headed Alpines are spreading at the expense of the Nordics and Mediterranean peoples It may be that it is inevitable, for if the Alpine races be equipped with somewhat higher racial attributes (as some ethnologists are inclined to believe), then the differences, however slight, may be enough to ensure its final supremacy (see Chapter xxxiv)

Note on Primitive Man in China

In North China are three interesting localities which are shown in Fig 82 Near Peking is Chou Kou Tien (pronounced *Choh kow Dee ayn*) where a dozen specimens of early Pleistocene man have been found This type has been called *Sinanthropus*, and is between *Pithecanthropus* and Neanderthal man, but much nearer the former⁶

In 1926 Père Licent showed me in Tientsin the enormous collections of Palaeolithic and Neolithic tools, which have been made by himself and Père de Chardin The Palaeolithic artefacts came mainly from Chou tung kou (500 miles west of Peking) They comprise Mousterian "points," "grattoirs" and "burins," mostly chipped only on one face Five other localities, mostly east of Chou tung kou, yielded similar artefacts A Neanderthal skeleton has been found near Kuznetsk in Siberia

At Linn Si (300 miles north of Peking) many beautifully-made arrowheads in quartz and jasper were found, as well as large leaf-shaped Neolithic tools about 27 centimetres long Some of the latter specimens are completely polished and have pointed oval edges They were probably *hoes* used in their fields of grain, and resemble similar tools of the Amerinds⁷

⁶De Chardin 'Sinanthropus' (*L Anthropologie Paris 1931*)

⁷Licent and de Chardin 'Le Paleolithique et Neolithique de Chine' (*L Anthropologie, Paris 1925*)

Fundamentals of the Present Population

In Figs 83a and 83b are charted the crops and minerals of Asia with a view to explaining the main features which determine the present distribution of population. In the north there are no crops at present though judging from European practices we may see hay and barley spread into the cooler coniferous forest or Taiga (Fig 58). Today wheat is grown on a considerable scale in the cooler parts of Asia all round the central mass of high Young Mountains. Extensions of this wheat culture spread into India and Anatolia. The belt of desert lands is marked in the west by the growth of dates much as in Africa. Cotton also comes from irrigated areas in the arid environment as we can see in Russian Turkestan.

In the cool temperate but well watered coastlands of North China we find a series of crops such as soy bean wheat maize and cotton which are arranged in the same order as in the similar regions in Europe and Africa. The hot wet monsoon lands of south-east Asia offer a suitable environment for the growth of rice along the coast with tea in slightly cooler higher areas. Tobacco hemp (from banana leaves) sugar and copra come from the wet lands near the Equator. A patch of winter rain crops such as olives and oranges is to be seen in the extreme western portion of Asia near the Mediterranean Sea.

As regards metals iron zinc and gold are rather abundant in the old rocks of Siberia. In the old relic blocks of China are some of the best sources of mercury antimony molybdenum and tungsten. The two latter metals are very valuable in steel alloys. The granites of Malaya are the world's richest source of tin. The ancient shield of Southern India contains a good deal of gold and gems and perhaps the largest deposits of the transparent mineral mica. Japan has much copper but lacks abundant sources of other metals.

The valuable oil resources here as elsewhere are associated with the Young Mountains. Favourable sites for oil occur all the way from Baku (near the Caspian Sea) to the folded island areas of the East Indies. Especially in Iraq and Iran are there valuable petroleum areas while others occur in Burmah. (Compare the oilfields with the fold mountains shown in Fig 3). Coal is much more abundant in Siberia than was formerly supposed and the Tungus field is one of the world's richest coal areas. The field long known to occur in Shansi in China is probably not so large as was at first reported. India is not very well endowed with coal but the Raniganj field near Calcutta supplies the fuel to the adjacent iron smelting town of Jamshedpur.

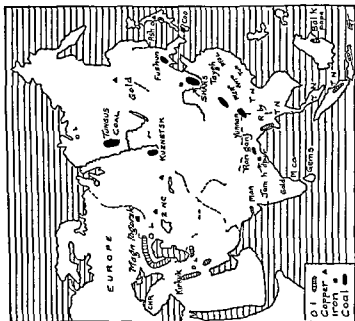


FIGURE 83b.—Mining fields of Asia. Notice that the coal is mostly in the well watered regions while the oil is associated with the Young Mountains

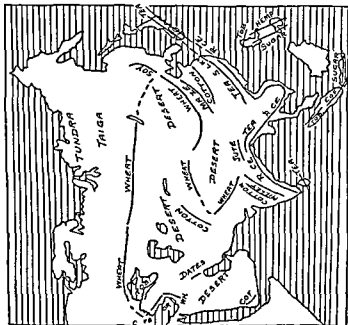


FIGURE 83a.—Crop zones of Asia. Compare the order of the zones in the east with those in similar latitudes in other continents

CHAPTER XVIII

THE CHANGING ENVIRONMENT IN NORTH AMERICA

A General Topography

An examination of the topography shows that there are two centres of great elevation, one in Greenland and one in the Western United States (Fig 84). Of these the Greenland Plateau consists of a vast compact area all over 5 000 feet high, and covered with a thick ice-cap, while the western region is built up of a series of ranges and elevated intermont basins, which have been developed in connexion with the Tertiary mountain building period.

The history of man in America in all probability commenced after the topography had reached comparative stability. Probably no one seriously entertains the theory that the American Indian (Amerind) originated in America, and the great majority of ethnologists concur that his ancestors entered late in the Pleistocene period from Asia. Some skeletons discovered near Los Angeles early in 1924, however, seem to date from interglacial times, and there is little doubt in the writer's mind that descendants of "Interglacial Migrations" still survive in South America. For instance, referring to the cranium found at Punin in Ecuador, 1923, Anthony says 'Weighing all the evidence carefully, I think serious consideration must be given to the implied contemporaneity of this cranium with the *Pleistocene* species of the Punin beds' (See p 256).

It has been pointed out by W M Davis that the North American topography resembles that of Europe as the left hand does the right hand. On each side of the Atlantic Ocean is an ancient 'Shield' or crustal block. The Laurentian Shield of East Canada corresponds somewhat in age and position with the Russian Shield. The Great Lakes resemble the Baltic Seas. The ancient ranges of the Appalachians agree with the ancient relics of the Hercynian chain across Europe. Farther from the ocean in both continents are the great plains while the young mountain-chains of the Western States correspond in age with the "Alpine Storm" of Central and South-Eastern Europe. The West Indian islands and seas, moreover, fairly agree with the arcs and deeps of the Mediterranean.

The structure of Canada is considered in some detail in Chapters II and XII. In the United States conditions are somewhat the same,

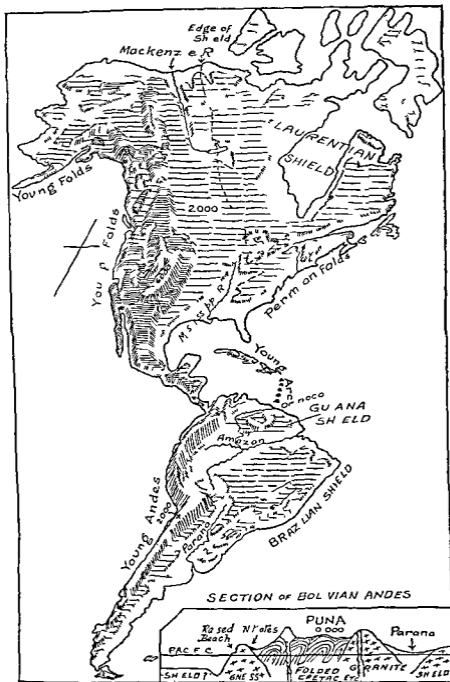


FIGURE 84—Generalized block-diagram of North and South America
The geology of the Andes in north Chile is shown in the section

but there are sufficient differences to make it worthwhile to examine Fig 85 Here a profile section across the United States (somewhat generalized) is charted In the lower sketch the geography of Cretaceous times is given The land was worn down nearly to sea level and a vast Cretaceous Sea occupied the actual 'Middle West' of the United States

Early in Tertiary times the weak deposits in the Cretaceous Sea were folded to form the Rocky Mountains Smaller earth folds to the east built up the Bighorn Mountains and the Black Hills A vast high plateau (later trenched by the Grand Canyon) was elevated,

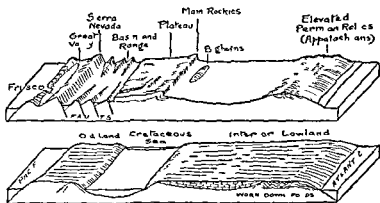


FIGURE 85—Two generalized block-diagrams showing part of the United States in Cretaceous times (with the large sea) and in late Tertiary times with the Rocky Mountains (Partly after Loomis)

without folding just west of the Rockies The area west of this was not folded but broke into great crustal blocks separated by faults The Sierra Nevada is the largest of these blocks The areas between the tilted blocks form basins filled with silt and the whole region is called the 'Basin and Range' area Close to the coast minor folds during the Tertiary produced the Coast Ranges and the 'Great Valley'

Great sheets of lava have poured out in the north west states and beautiful volcanic cones draped in glaciers as on Rainier and Shasta rise to 15 000 feet in this region The hydrography shows that the elevation belongs to late geological epochs The Colorado Canyon is a classic example of rejuvenation One of its tributaries the Virgin

River, is supposed by some authorities to have originally risen in Wyoming and flowed south through the Salt Lake region to join the Colorado, thus cutting right across the Rockies. So also the Columbia extends practically across the mountain belt proving that the rivers are not yet adjusted to the late Tertiary movements.

The growth of the American topography is, however, of great secondary importance to man. The Great Ice Sheets which dominated Canada and the Northern United States spread out in accord with the topography and gave rise to an environment which still controls man's activities to a very considerable extent. A clear summary of the conditions is given by Brooks in his *Evolution of Climate*,¹ on which the following account is based.

The Pleistocene opened with extensive elevation of the whole North American Continent, which raised the Rocky Mountains several thousand feet above their present level, and extended the continental area over much of the northern archipelago. Newfoundland was also raised 1 000 feet. The high mountains in the west were the first to develop large glaciers, which coalesced into an ice-sheet perhaps 5 000 feet thick. It extended south-east into the United States, and at the same time perhaps another ice sheet moved south from Labrador. An interglacial period probably followed, in which the Asiatic hairy mammoth roamed through North America.

The *Kansas Glaciation* followed, when the ice-sheets reached their greatest extent. The Keewatin region (west of Hudson Bay) also developed a very large ice sheet at this stage, when the climate, though severe in winter, was not unbearable in summer. Even as far south as Florida the effect of the glaciation was felt, for northern plants which migrated then still remain on the colder slopes of the hilly southern country. There followed a long interglacial stage which perhaps endured for 200 000 years and which may correspond to the Mindel Riss Interglacial of Europe.

Various less clearly defined Ice Ages succeeded, which were followed by a period of dry steppe like conditions, when the great American loess sheet was deposited. The Peorian Interglacial is supposed to have lasted for 60 000 years, and then came the last or *Wisconsin Glaciation*. It has been calculated that 20 000 years have elapsed since the ice finally abandoned the Niagara region.

¹C. E. P. Brooks *Evolution of Climate* (London 1922)

B *Climatic Control*

The migrations of early man and the recent white settlement of America both mainly depended on the three great geographic controls of topography, temperature, and rainfall. The usual maps of temperature give a misleading idea of conditions in the west of America for the isotherms are often reduced to *sea level* temperatures.

In Fig. 86 however, the actual temperatures at the places concerned are given. The striking 'cold loops' in the isotherms (projecting southwards) show clearly the effect of the mountains. (These loops do not appear in *sea level* isotherms.) The cool conditions in summer in Mexico, much of which near the capital is below 64° F. in

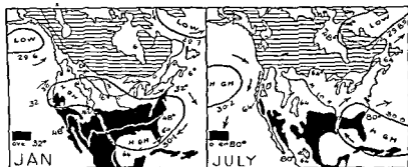


FIGURE 86—Temperatures (thin lines) and Pressures (heavy lines) in North America. Cold loops on mountains are shown dotted. Notice the great range of temperature along the east coast in January. (After Philip)

July are obvious. The second interesting feature in the isothermal map is their close set arrangement on the east coast in January. From the St. Lawrence to Florida there is a range (lapse rate) of nearly 64° which is probably the greatest change of its kind in the world. On the Pacific Coast the change is always slight, even in January. In July the drop in temperature as we proceed north from Florida to the St. Lawrence is below 20° F. This is nearly the average lapse rate of 1° F. for each degree of latitude (69 miles).

The pressure distribution is also shown (by the heavy lines) in Fig. 86. In January there is a High over the United States owing to the land being colder than the oceans. In July the High moves over to the relatively cooler oceans. The controlling factors however, are the moving cyclones (Lows) which pass from west to east (es

pecially along the United States-Canadian boundary) fairly regularly through the year

Another important climatic feature is the large extent of land in Canada and Alaska with an annual range of temperature (hottest to coldest month) of more than 50° F (Fig 146) This means that these regions have a hot summer, where the temperature often reaches 90° F For instance, Stefansson quotes 100° F as having been registered at the official bureau at Fort Yukon, which is north of the Arctic Circle in Alaska On the Coppermine River, about fifty miles north of the circle, Stefansson describes one period of three weeks when there was not a cloud in the sky, the sun beat down upon them the twenty-four hours through, and the heat rose to the vicinity of 90° F in the shade without dropping lower than 60° at night Those three weeks, he adds, were certainly equal in opportunity for plant growth to six weeks of Texas, and they were by no means the whole summer²

In winter (January) the isotherm of freezing (32° F) approximately extends from New York to St Louis and Denver (Fig 86) All to the north is frost bound, and extremely low temperatures (such as 62° below zero in Montana) are known in the heart of the great land mass away from the equable temperatures of the ocean

Turning now to the rainfall (Fig 87), we find that conditions are somewhat the same as in Europe There are two regions of heavy and uniform rainfall, in British Columbia (due to the constant westerly winds) and in the Eastern United States Of true winter rainfall there is only a small patch on the Californian coast The centre of the continent (from Great Bear Lake to Mexico) has mainly a summer rainfall, and east of this there is also a considerable amount of rain in spring and autumn also Similar conditions obtain in Mexico

The arid regions (under 10 inches) occur in the north in the area between Lake Athabasca and Baffin Land, and in the south west in Arizona and Nevada The official *Atlas of the Vegetation of the United States* (1924) names as *desert* almost all Nevada, most of Utah, and half of Arizona and Wyoming While the desert in this part of America is of small proportions compared with, say, that in Sahara or Australia, it is by no means negligible, as Bowman has recently pointed out in the following words "A desert has become by definition not naked sand or rock, but a place of small rainfall, with a

²V Stefansson *The Northward Course of Empire* (New York, 1922) p 35

sparse and specialized plant and animal life . . . Because settlement in the Central United States has steadily pushed back the borders of the American desert, it is sometimes supposed that the word 'desert' can be discarded entirely . . . As a matter of fact we have an extensive area, as truly desert as Sahara or Atacama "3

C Vegetation

The vegetation responds directly to the seasonal rainfall (Fig 87) In the north is the *tundra*, extending along the coasts of Alaska and Northern Canada to Ungava Bay According to Stefansson⁴ there is,

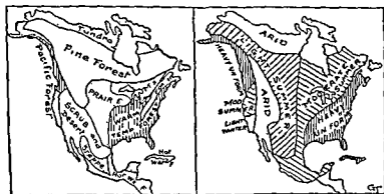


FIGURE 87—Generalized vegetation and rainfall in North America

however, very little snow on the tundra "In winter it is thinly snow-covered, and the grass in most places can be seen sticking up through the snow In summer it is green with grass and golden with flowers, and there is never a speck of snow " He estimates that in Northern Canada there are one and a half million square miles of land suitable for grazing caribou (reindeer) herds

The southern edge of the tundra is very ill defined and merges slowly (as a *taiga*) into the great coniferous forest This *taiga* extends much farther south than in Asia, probably (as Hardy suggests) because of the chilling due to the proximity of the extremely cold ice-cap of Greenland

³*Desert Trails* (New York: American Geographical Society, 1924)

⁴*Op. cit.*

We may divide Southern Canada and the United States into two halves corresponding to the seasonal rainfall map. The western *arid* and *summer rainfall* regions consist of scrub and steppe lands respectively; the eastern more or less *uniform rainfall* regions are (or were) occupied by dense broad leaf forests, probably the finest of their kind in the world. Oak, walnut, hickory, chestnut, alder, willow, poplar, elm, magnolia, laurel, maple, and many others flourish in profusion. No doubt these forests in the east formed a safe refuge for the early "dokeph" Amerinds, where they retreated from the thrust of the later Alpine peoples. We shall see that the Indians of the Plains and Highlands (i.e., the great corridor of migration) were chiefly broad-heads, while the Indians of the dense eastern and northern forests were chiefly long heads.

Along the western coasts there occur heavy forests, usually of conifers such as spruces and firs, among which are the *Sequoias*, the largest trees on earth. In these steep and inaccessible valleys dwell a large number of shattered tribes displaced to the west by the hordes of more powerful Plains Indians.

D Recent Climatic Changes in North America

Some of the most important evidence as to these changes has been collected by Ellsworth Huntington in his book *Civilisation and Climate*.⁵ Owens Lake is situated in Southern California, and receives its waters from Owens River (Fig. 88). The last overflow is determined to have occurred about two thousand years ago, by estimating the amount of salt which has accumulated in the lake. Two thousand years ago the climate of the region was so moist that the lake expanded to two and a half times its present size. About the same time the adjoining Pyramid Lake rose to 70 feet above its present level and overflowed also.

The various lake beaches show that these rises and falls of the water have been intermittent, and it is possible to correlate the wet and dry periods with the quick and slow periods of growth of the very ancient trees of the neighbouring forests of the Sierra Nevada. Huntington deduces a very dry period about A.D. 650, followed by a rather wet period at A.D. 1000, an extremely dry period at A.D. 1250, and a wet, stormy period (deduced from gravel beaches) about A.D. 1350. Far away in Lake Lob Nor in the north of Tibet we have seen

⁵New Haven, 1915

that the waters rose with great rapidity about this time, showing that there were similar changes in similar latitudes in both hemispheres. This is not surprising when we realize that the moving cyclones (or Lows), which bring the rain, pass regularly from the United States across the Atlantic to the Old World, in their everlasting procession around the North Pole.

Even more apposite, however, is Huntington's study of the effect of environment on race in Yucatan and Guatemala. Here lived the Mayas who had developed a civilization in some respects higher than that in any part of the world except Western Europe. Their calendar



FIGURE 88 —Sunspots and rainfall in North America. When sunspots are few the ruled areas are wetter and the dotted areas are arid, and vice versa. (Data from Huntington.)

was more exact than that used until recently in Russia. Their writing was phonetic, and in this respect ahead of the Chinese script. The most surprising feature of their civilization is that this region is now a hot, damp malarial lowland, where agriculture is practically impossible, and where only a degraded handful of Indians now dwell. Even these are subjected to repeated attacks of malaria.

Huntington's explanation seems to be the sole possible one (Fig. 88). He believes that the climate has changed owing to a shifting of the rain belt. Unfortunately he cannot correlate the climate with early Maya history, for we do not know their dates accurately enough. The seventh century A.D. was a period when the Maya civilization was at a low ebb. At this time the California trees grew very slowly, rainfall here was scanty since the southern desert belt had now moved north. As a natural corollary the southern tropical rain belt also

moved north from Southern Guatemala into Yucatan, giving for a time conditions something like those of today

The forests became rank, agriculture would be difficult, disease would be rife and the vitality of the Mayas in Southern Yucatan and thereabouts would be sapped. From A.D. 900 to 1100 the California trees grew rapidly. At such a time the desert belt had moved south, and on its southern border favourable *driser* conditions would prevail in the home of the Mayas. At that time occurred the last great revival of architecture and the construction of the great buildings whose ruins now adorn Southern Yucatan.

Huntington goes farther and demonstrates that these swings of the dry and wet belts are most probably in accord with the variations in solar energy. I cannot do better than quote his own words on this important subject

The changes of the eleven year cycle [of solar heat] seem to be of the same nature as those during the larger cycles [of climate] both in historical times and in the geological past. To go back to the glacial period the northerly areas of increased storminess at times of many sunspots correspond with the places where the main ice-sheets were formed. The areas of diminished storminess coincide with the places where the loess was deposited [referring to the map reproduced in Fig. 88]. In the south west of the United States the dotted area showing *great increase of storminess at times of many sunspots* is the region where scores of old lake strands indicate that the rainfall was once so abundant that dry basins were filled with water. Abundant ruins in the same region where it now seems impossible for people to get a living are located in exactly the area where storms increase at times of many sunspots.⁶ [See also Fig. 142A.]

No doubt there are other cycles in the sun's intensity besides the familiar cycle of eleven years. Huntington believes that another cycle of about one hundred years is indicated, with a minimum about 1924 and maxima about 1870 and 1970. It must be remembered, of course, that in certain regions these periods will be marked by greater *dryness* as the arid belt will then move over them. Some such change in the environment probably accounts for the deterioration of the Pueblo civilization in the arid United States. It is now too dry there, just as it is too wet in the Maya region.

Clements and Chaney in their recent memoir on *Environment and Life in the Great Plains*⁷ discuss this same problem of climatic change

⁶E. Huntington and S. Visser *Climatic Changes* (New Haven, 1922)

⁷Carnegie Institution 1937

fairly fully They believe that the major migrations of the Amerinds into North America occurred some twenty thousand years ago

The most plausible view regards them as moving from Asia at a time of relative emergence [of the continent] when the climate was warm and dry An open type of vegetation such as grassland or savannah not only rendered migration relatively easy but also provided the game necessary for the support of nomadic hunters It is not improbable that tundra and prairie were in contact at this time thus forming a broad pathway for movement This assumption is favoured by the presence of a number of grassland relics today as far north as Alaska, and along the Arctic Coast.

Fundamentals of the Present Population

The distribution of the crops of Canada and its bearing on the population will be considered in a later chapter (p 334) In Fig 88a the optima for the crops of the United States and Mexico are charted The 20 inch isohyet bounds the well watered lands in the eastern portion of the United States and within this eastern half the crops are arranged in the series which we have already encountered in the other continents Thus, reading from north to south we traverse belts of sprung wheat and oats in the far north These are flanked on their southern side by flax and apples Still farther south come winter wheat maize millets and tobacco

In the warm temperate and subtropical portions of North America (Fig 88a) appear cotton pea nuts sugar and oranges In the hot wet lands of the West Indies we find sugar and tobacco while on the adjacent Mexican coasts are sugar and sisal (hemp) The elevated plateau of Mexico grows the crops of cooler latitudes such as wheat maize and coffee

No other portion of the world is so well endowed with minerals as North America and the chief fields are shown in Fig 88b The great Canadian Shield occupies the north-east of the continent and no doubt much of it is still unexploited However round the margins we find various mines such as the second largest goldfield of the world near Porcupine and Rouyn In the north west is the chief radium mine near the Great Bear Lake Almost the whole world's supply of the valuable metal nickel comes from Sudbury which is also the leading source of platinum at present Very large deposits of iron occur in this Shield at Mesabi Steep Rock and Bell Island (in Newfoundland) For the huge coal deposits of Alberta see page 369

The core rocks of the Rockies and of the ranges nearer the coast are very ancient and contain many valuable minerals In the far

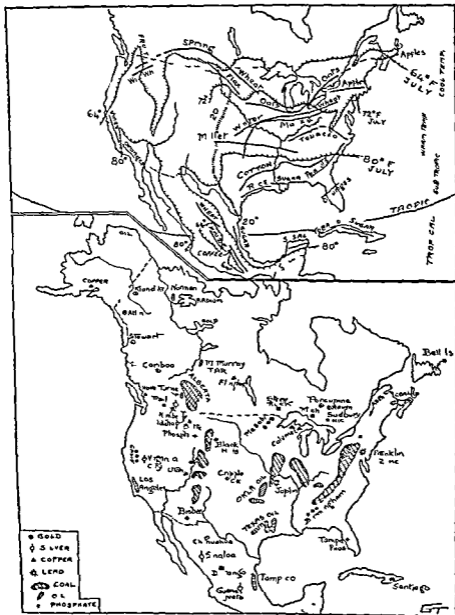


FIGURE 8Sa—Crop zones of North America Notice that the 20-inch rain line bounds the chief crops on the west Compare the crops with the July temperatures

FIGURE 8Sb—Mining fields of North America Notice the valuable minerals found on the margin of the Canadian Shield The chief coal and oilfields of the world are charted on this map Black squares are iron

north we find copper in Alaska and gold at Klondike Atlin Stewart Cariboo and Trail also have important gold mines in the vicinity The lead zinc of Kimberley is one of the largest deposits in the world California was long famous for its gold mines while silver was equally rich at Virginia City nearby However Idaho is more noted for its silver today Some of the greatest copper mines in the world occur at Butte Utah and Bisbee Gold mines are found in the ancient rocks near the Black Hills and Cripple Creek Small exposures of older rocks in the east of the United States account for the lead zinc of Joplin and of Franklin (near New York) The phosphate rocks of Tampa in Florida are quite important

It is in regard to coal and oil that the United States is outstanding In both cases about half the world's resources are found in this one country Probably the greatest coal deposits on earth are to be found in the Rockies between Alberta and Mexico and they have been very little exploited to date The eastern fields contain better coal but it is not nearly so abundant There are three main oilfields in Texas Oklahoma and California Others of less importance are found in Pennsylvania Turner (Alberta) and Norman in the far north west of Canada Comparative data in regard to these minerals will be found in Chapter XXXII

Mexico like the United States is very rich in metallic minerals It is the leading silver producer in the world the chief mines being found near Guana juato and Sinaloa Gold at Chihuahua and a large but unexploited mountain of iron at Durango are other examples of Mexico's riches The oilfield near Tampico for a time contained the largest oil wells on record and Mexico is still an important producer of petroleum In the West Indies perhaps the iron deposits of Santiago in Cuba are the chief metallic sources of note

Very large deposits of rich iron ore have been surveyed on the Quebec Labrador border It is proposed to build a railway 360 miles long from Seven Islands (on the Gulf of St. Lawrence) northward to this Burnt Creek area In Alberta new oilfields as at Leduc near Edmonton are superior to the Turner Valley field

CHAPTER XIX

THE CHANGING ENVIRONMENT IN SOUTH AMERICA

A Structure of South America

It seems probable that South America was the last continent to be reached by primitive man. We have seen that there is some evidence for the Tasmanian having entered Australia in mid Pleistocene times. But it is not impossible that such primitive types entered America. One must remember the American migrations of the Asiatic mammoth, which may have been followed by early man.

The changing environment in the southern continent during late Tertiary times has not, therefore, affected man quite so much as in the Old World continents. But the effect of the modern environment upon primitive and civilized man is as marked here as elsewhere and, in one particular, South America is unique. I refer to the very narrow corridor which connects the northern portion of South America to the southern portion. This is due to the close proximity of one of the highest plateaux in the world to the largest and most impenetrable of tropical forests. We may, therefore, briefly discuss the salient features of South American physiography.

The topography consists firstly of a large Brazilian "shield," possibly once united to the smaller Guiana "shield," but now separated by the broad trough of the Amazon. The second feature is the long belt of lowlands which extends from Buenos Aires northward to the mouth of the Orinoco. The divides between the La Plata, Amazon, and Orinoco are exceptionally low. We are told that the deflection by a falling tree may deviate the streams into one or other of the two first rivers. We know of the remarkable bifurcation of the Cassiquari which links the Amazon to the Orinoco just south of the Sierra Parima (see Fig. 84).

The third great feature is the Andean Range with its numerous ridges, plateaux and basins. Data as to the age of the uplift are much less certain than in the other "Young Mountains" of the world. But E. W. Berry (in 1917) gives evidence leading him to suppose that the Bolivian Andes may have risen to a minimum of 13,500 feet since late Tertiary or even Pleistocene times.¹ The wonderful gorges of the

¹ Age of the Bolivian Andes. (*Proceedings of the National Academy of Sciences* vol. III, 1917.)

tributaries of the Upper Amazon such as those of the Urubamba investigated by Bowman² are also indicative of rapid uplift. At the Pongo de Mainique the huge river is only 50 feet wide in a gorge bounded by 4 000 foot cliffs yet it is so deep that there is little current.

Far more significant than any of the highlands of North America is the extensive Peruvian and Bolivian Plateau. This vast bleak area known as the *Puna* extends north and south for some 1 500 miles with an average width of approximately 200 miles. Almost all this plateau is over 10 000 feet high. It thus ranks with Tibet, Greenland and Antarctica as one of the four great plateaux of the world. On the west it descends steeply to the coast and thence down into such deeps as the Atacama Pit nearly 25 000 feet below sea level. The total difference of height from the mountain tops to the bottom of this giant scarp is therefore 45 000 feet and it thus rivals the similar lately formed scarp of the Himalayas.

The build of the Andes is much like that of the Rockies and other Young Mountains which we have already considered. The section inset at the foot of Fig. 84 shows the main features. In Cretaceous times a broad earth trough (syncline) occupied much of the western part of the continent. When the Tertiary period of stress and strain (the *Alpine Storm*) began two great resistant shields, i.e. the Pacific and Brazilian Shields, squeezed the weak sediments laid down in the Cretaceous Sea between them. Thus a series of north-south ridges was formed, much as in British Columbia (Fig. 4). In the latitude of the Tropic of Capricorn we find a coastal range on the west, then a broad low area of desert, then the main region of folded and elevated Cretaceous sediments called the *Puna*. The eastern part of the Andes is here built up largely of granite. High volcanic cones are common, especially in the western ridges. There is a broad syncline just east of the Andes, drained by the tributaries of the Plata. To the east the land rises considerably to the higher parts of the Brazilian Shield which lie near the Atlantic.

B Topographic Control

Some characteristic features of the Andean Plateau in Peru are illustrated in the following block-diagram. The highest zone is occupied by shepherds, one hut in use being 17 000 feet above sea level to the west of Cuzco. The high pastures extend up to the snow line (generally at 15 000 or 16 000 feet) and occupy the old *undissected*

²*The Andes of Southern Peru* (New York 1916)

plateau surfaces There is a zone of better rainfall about 10 000 feet, and here wood lands and mountain farms occur (see Fig 89B) Potatoes will grow here in spite of repeated frosts Barley and wheat are also staple crops

The glacial cycle has been very marked here, within 12° of the Equator Great glacial troughs have been cut in the plateau to depths of as much as 7,000 feet Often the flat floor of these canyons is covered with gravel and is too arid for agriculture except by irrigation from the wetter heights In this latter case sugar, bananas, and cacao are grown at elevations of from 5 000 to 8 000 feet (Fig 89) There is evidence in many places of several stages in the glacial cycle



FIGURE 89—Two block-diagrams illustrating the Colombian and Peruvian Andes The variation of crops with altitude is charted

Thus two miles below Choquetira (west of Cuzco) the valley at 11,500 feet is filled with much dissected moraine and outwash One mile below the village is a second moraine, and just above the village is a third of very recent origin Cirques and hanging valleys are common, while moraines are forming at the snouts of the small glaciers on Mount Pantá (18 263 feet)

Sievers states that there were at least two distinct glaciations in Peru The present limit of the glaciers here is about 15 200 feet, but during the first glaciation they descended to about 11 000 feet, and during the second to 12 800 feet These data corroborate the evidence at Choquetira

No part of the world illustrates more clearly the effect of elevation upon settlement than the Andes The writer made a special study of this problem in December, 1930² and his main findings are summarized

² Settlement Zones of the Sierra Nevada de Santa Marta Colombia (*American Geographical Review* Oct 1931)

in the sketch shown at the left of Fig 89 From the tropical shore one can see the small glaciers on the peaks of the Andes, 19,000 feet above the sea At sea level is the ancient Spanish town of Santa Marta which originated in 1502, perhaps before any other European settlement on the mainland of America Immense banana plantations (mainly planted by the United Fruit Company of Boston) are maintained by irrigating the semi arid lowlands below the Sierra Sugar-cane is grown on the lowest slopes, which are clothed by a dense jungle of rather small trees and shrubs Between 3 000 and 5,000 feet are many small coffee plantations especially below the Cerro Quemado A few sheep have been grazed on this peak Further south the primitive Spanish culture of the lowlands gives place to the almost untouched Indian culture in little villages like San Andres (S in Fig 89A) Here, apart from a musket or two and some cattle, the Indians have changed their manner of life very little since the Spanish conquest Unused jungle reaches to 9,000 or 10 000 feet Here begins the grass land or *Paramo* in which Indian cattle run almost wild Above 17 500 feet is permanent ice, and glaciers border the highest peaks

C Climatic Data

The present climates of South America are naturally very diverse Nowhere in the world do the isotherms bend so sharply as along the narrow but high Andean chain Current isotherm maps (reduced to sea level) are far from the reality here, for they show us the Bolivian Plateau with an average temperature of 75° F while in truth La Paz (one of the chief cities) has an average of 49° F, and a June temperature of 44° F (Fig 146)

The rainfall conditions vary very remarkably in accord with the swing of the sun and with the diverse topography As regards season, the Amazon and Orinoco Basins being nearly under the sun all the year round have a heavy uniform rainfall (Fig 90) The greater part of Brazil has a summer (and autumn) rainfall, though it becomes fairly uniform in the south and in Uruguay Almost all the west coast and the Patagonian region have a low rainfall, below 15 inches There is an interesting exception, however, in the south coast of Chili which receives a very heavy rainfall from the constant westerlies Near Valparaiso is a small region with a typical "Mediterranean" rainfall which is confined to the winter

D *Vegetation in South America*⁴

The region of heavy tropical rainfall supports the densest vegetation in the world (Fig 90). An equable high temperature through the day (and even through the year) of about 80° F gives the very conditions for maximum growth, and here indeed we find the supreme effort of plant life. The Amazon acts rather as an irrigation agent than as a means of drainage so that on the banks of the rivers there springs from the slimy mud a rank and dense growth of tall trees (including the Para rubber tree) which form, under an unbroken canopy, a green wall impenetrable from the outside. Beyond these flood forests is the typical *selta* on firmer ground. It is taller than the

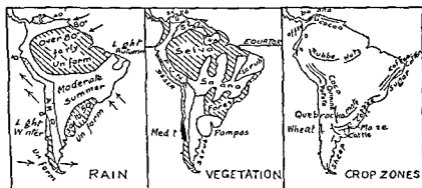


FIGURE 90—Rainfall, vegetation, and associated crops in South America

former, and here the Brazil nut tree is common. The vast crescent of Andean slopes on the west is called the "Montana". Here the thick selva rises up to 4,000 feet, and above this to 7,500 feet is the dense rain forest of palms, lianas, ferns, and bamboo (see Fig 90).

This dense mass of forest, therefore, extends right across South America from the mouth of the Amazon almost up to the Andean Plateau. It is likely to be almost the last terrain conquered by man, for, as Bowman forcibly puts it "The tropics must be won by strong hands of the lowlier classes, who are ignorant or careless of hygiene, and not by the khaki-clad, robust young men like those who work at Panama.

It is pleasant to think that the forest may be conquered. It is nonsense to say that we are now conquering it in any comprehensive and permanent way.⁵ The invention of a small "air

⁴Based on Hardy's excellent handbook *Geography of Plants* (Oxford, 1920)

⁵*Andes of Southern Peru* p. 35

cooling unit which can be widely used in the tropics will no doubt greatly ameliorate the life of those white folk who can afford to use it. Possibly it may become as general as 'central heating' (in higher latitudes) in the not far distant future.

From 8 000 to 10 000 feet are woods of palms and some deciduous trees while a wood land zone of smaller trees resembling rhododendron reaches up to 11 000 feet. It is this less thickly clad region above 7 000 feet which forms the corridor for migrations from the northern portion of the continent into the south.

As we pass southward this open Alpine country naturally descends nearer sea level. The Argentine Andes have park land woods above 3 000 feet though gnarled *Quenoa* trees are found even up to 12 000 feet. Continuing along the eastern slopes of the Andes there follows a truly arid strip extending far southward. This district has known prosperous times when nearly every valley had its lake and its area of cultivation and supported a fairly large population with a comparatively high degree of civilization. Whether by natural or human causes or a combination of both this state of things ceased to be after the invasion of the Europeans.⁶ There is no doubt that on the *Pacific* slopes of the Peruvian Andes the belts of vegetation and cultivation of the Incas and Quichuas were broader than now. This change also is probably due to a marked deterioration in the rainfall.

To the north of the selvas are the grass-lands (savanas or *Llanos*) of the Orinoco Basin (Fig 90). It is difficult to understand (in view of the uniform rainfall) why this region is not heavily forested. Possibly the grass lands are a heritage of earlier and drier steppe conditions and the forest has not yet recovered its hold though the rainfall has become heavier. Clements and Chaney have suggested this as the explanation of much of the northern prairie floras.⁷ This open country has no doubt led to the rapid migration of the Caribs from the main corridor far into the domain of the earlier Arawak tribes. South of the Amazon selvas are similar *savanas* extending through Southern Brazil in accord with the marked seasonal rainfall. As the rain becomes more uniform in Uruguay and thereabouts forests of *Araucaria* become common. To the south again come the grass lands of the *Pampa* with a fair rainfall chiefly in summer. Here man has little difficulty in rearing his flocks and herds and in

⁶Hardy *Geography of Plants* p 160

⁷*Environment and Life in the Great Plains* op cit

growing valuable crops, so that here settlement has progressed more rapidly than anywhere else in the continent

The great Andean Ranges have sheltered Patagonia and West Argentine from the westerly rain bearing winds. They lie in a rain-shadow which gives rise to a vast arid or desert region extending along the flanks of the mountains on the east. The shingle plains are sparsely clad in bushes with thorny or leathery leaves, with much salt bush in the numerous marshes. To the north of latitude 35° the east becomes the rainy side of the mountain barrier, and the rain-shadow desert shifts to the west. Here one of the driest tracts in the world extends from Coquimbo almost to Guayaquil. The following figures (from Kendrew) for Iquique* illustrate probably the lowest rain record in the world

INCHES OF RAINFALL AT IQUIQUE

Jan	Feb	March	April	May	June	
0	0	0	0	0	0	
July	Aug	Sept	Oct	Nov	Dec	Annual
0.02	0	0.03	0	0	0	0.05

A quotation from Brooks, *Evolution of Climate*, sums up the scanty literature on the changing conditions in the lowlands. The Pampas formation in the Argentine consists of 200 000 square miles of deposits allied to Loess. These seem to indicate former steppe conditions prevailing on the equatorial side of the Patagonian ice sheet of the Pleistocene. But before the greatest cold these were partly forest-clad, as is indicated by the remains of giant ground sloths. The proximity of the great Andean glaciers with a more or less permanent anticyclone lying over them, probably led to very arid conditions in these southern lowlands. Hence the sloth and also the horse completely died out in South America.

In the final drawing in Fig 90, I have shown the crop zones of today. These are closely linked with the climatic zones and form an interesting mixture of European and native culture products. Surrounding the most equatorial region are the zones where rubber and Brazil nuts are gathered. Farther away are the zones of sugar, coffee and cotton. Still farther grow the peculiar tree-crops of *mate* (tea) and *quebracho* (for tanning). More familiar crops are arranged in zones in the temperate regions of the far south of the continent

*Pronounced Ee Lée Jay

copper and silver are worked Chuqui camata in northern Chile is another great copper mine, while Braden to the south is also notable The tin of Bolivia was of great importance, when Malaya was in Japanese hands The petroleum of Maracaibo in Venezuela is the best in South America though Argentina has some supplies near Jujuy Coal is rather rare except near Concepcion in Chile Colombia in the north west supplies important amounts of such rare products as platinum and emeralds

In former days the guano beds on the arid islands off Peru were very important sources of phosphorus fertilizer, but they are now exhausted So also in the past the nitrate beds of the Chilean desert gave great prosperity to that state Of late years the synthetic nitrates, made from the nitrogen of the air in Germany and Norway, have largely done away with the monopoly held by Chile These nitrate products are invaluable as fertilizers and as a source of explosives

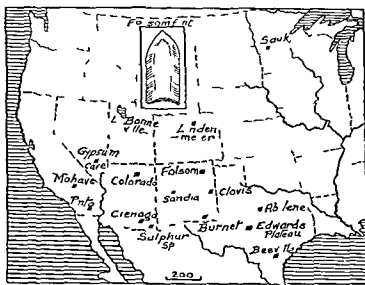


FIGURE 90b—Early Folsom (?) Migrations into USA based on J McGregor and others (See note on p 263)

CHAPTER XX

THE RACES OF AMERICA

It has been customary to classify the Amerinds (i.e. American Indians) in one of two ways. Either they are assigned to the *Mongolian Race* or they are separated as a special race or sub race—the *American Race*. The original idea that they were specially characterized by a red colour has long been given up as a useful criterion though there is a tinge of red in some tribes amid the almost universal brown colour of the Amerind races. In 1919 I stated that the three or four major zones of migration were represented in America almost as fully as in any other part of the world. Though perhaps the majority belong to the higher Alpine races of man there are submerged strata allied to the Negroid and many large tribes more properly allied with the Mediterranean peoples.¹

Haddon in his *Races of Man*² corroborates these deductions. He has the four following types. *Palaeo Amerind* or Lagoa Santa type whom he classifies with the curly haired dokeph peoples such as Indo Afghans and Nesiots. Secondly he divides the straight haired inhabitants of America into *Eskimo Northern Amerind* and a third group. The first are grouped by themselves the second with the Chinese and Palaeo-Asiatics and the third which he divides into *Neo Amerind* Tehuelche and North West Coast Amerind with the Turki Mongols and Southern Mongoloid.

All these have been subjected to the American environment for thousands of years so that a certain common facies tends to unite essentially distinct peoples just as we have seen in Europe. Common cultures and the spread of dominant languages have affected the Amerinds much as they did the Europeans. But just as we must drop the term European as an ethnic name so we must realize that the Amerinds are composed of many quite diverse stocks. In fact the general history of the migrations into America is extremely like that of Europe. Seeing that they started from a common centre we may possibly use our fairly accurate knowledge of European races to help us to elucidate the meagre history of American races. In both continents we find only a very small proportion of Negroid stocks

¹ Climatic Cycles and Evolution *op cit* pp 305-14

²A C Haddon *Races of Man* (Cambridge 1924)

chiefly as relics in the margins. In both the Mediterranean zone is fairly well marked on the edge farthest from Asia. In both by far the most abundant peoples are the Alpine races, which moved in last from Asia.

Let us glance at the ethnic criteria (Fig 91) The head index is

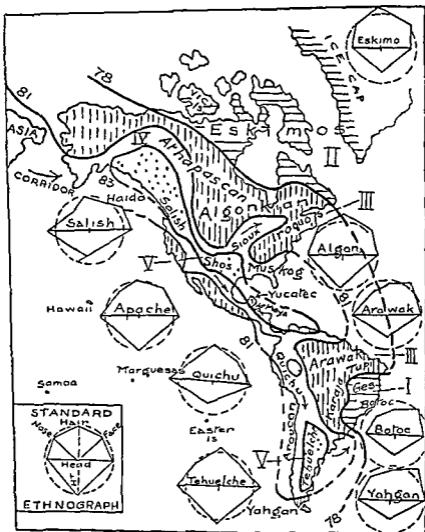


FIGURE 91.—The five main migrations into America from north-east Asia I The Palaeo-Amerind with Negroid affinities II. The Eskimo, an early Mediterranean type III The main Mediterranean migration. IV. The early Alpine type V The later Alpine type, still living in the common corridor of migration

fairly well tabulated. We find regions of dokephs concentrated chiefly around Hudson Bay and in Eastern Brazil. Of these the Karayas (73) and Botocudo (77) of Brazil are among the lowest. But the Greenland Eskimo (77) and the Hurons of East Canada (77) are on the same level, while many Arawak tribes (78) of the Brazilian selvas have heads very little broader.

Bordering these two areas of dokephs are wider belts of moderately broad-heads, such as the Algonkians (79) of Canada and many of the Brazilian Indians. In the far south the Yahgans (79) of Tierra del Fuego belong to this zone. The remainder of America, i.e., the western side, is predominantly broad-headed. The custom of deforming the head is likely to render the head indices doubtful in much of America from Vancouver to Peru; but this does not materially affect the map given in Fig 91. Von Eickstedt uses the same isopleths in his latest map.²

If we consult Biasutti's maps, we can generalize somewhat for the remaining criteria which are indicated in the following table, and also on the "ethnographs" on Fig 91.

Race	Locality	C I	Nasal index	Stature mm	Hair	Skin	Face
Eskimo	North-east Canada	75	Ca 72	1,500	Straight	Brown	Broad
Algonkian	South-west of Hudson Bay	70	Ca 74	1,700	Nearly straight	"	"
Salish	Southern British Columbia	83	74	1,650	"	Light- brown	"
Apache	Western Texas	83	80	1,700	"	Red- brown	Very broad
Mexican	Southern Mexico	79	80	1,600	"	"	"
Botocudo	Eastern Brazil	77	80 ?	1,600	"	Light- brown	Broad
Arawak	Northern Amazon	79	80	1,600	"	Brown	"
Quichua	Peru	82	74	1,600	"	Red- brown	Long
Tehuelche	Patagonia	83	72	1,750	"	Brown	Very long
Yahgan	Tierra del Fuego	79	?	1,600	"	Light- brown	Very broad

²Rassenkunde, *op cit*, p 689

Some uniformity is apparent in the character of the Amerind hair, which is most nearly like that of the Burmese and Indo Chinese, and not so straight as that of the folk of the centre and east of Asia. But there are numerous sporadic examples of curly hair. In regard to other criteria there is great variation, which would be much more strikingly displayed if the small 'relic tribes' could be inserted in the above table.

The nasal index seems to vary in a curious fashion with the temperature.¹ There is a region of somewhat platyrrhine peoples extending from the Columbia River (near Seattle) to the La Plata in the south east. All Canada and the Eastern United States in the north, and Bolivia and Argentine in the south are mesorrhine. The frozen north and Patagonia are markedly leptorrhine. The facial index is distributed in much the same way. Central America shows very broad faces, and almost all North America and Brazil is settled by broad faces, while narrow faces are found only among the Eskimo and Patagonians.

Stature has not quite the same distribution. It is true that broad noses, broad faces, and low stature characterize Central America but the North American is typically tall except for the Eskimo, who is quite short. In skin colour the distribution is not readily correlated with the other criteria. British Columbia and East Brazil are "light" poles, while Mexico and West Peru are "dark" poles. The majority of the Amerinds are of the same colour as the Burmese, i.e., brown, darkening to red brown at the "dark poles."

There seems little doubt that almost all the aboriginal peoples of America entered by way of the Bering region. Possibly some few may at times have been blown ashore in ships from the Pacific. There is some legendary evidence² for such a landing in Mexico, and the similarity between the architecture of Yucatan and Cambodia is remarkable. The temple pyramids in both cases are approached by four stairs with serpent balustrades. The altars are similar. There are even similar Atlantean figures supporting the doors, and some of the figures show whiskered men. Even more remarkable is the identity of the signs of the Zodiac in Asia and in Peru. The ram becomes the llama, the bull is the stag, the twins are man and woman, the crab is the octopus, and the scales are forks, etc. The Maya signs are somewhat similar. All this would seem to indicate that the

¹W. H. Holmes, 'Plurality of American Race' (*American Anthropologist* 1912 p. 30)

Central American civilizations borrowed from China or elsewhere within the last few millennia

It is not improbable that the Norsemen of Pre Columbian days penetrated somewhat farther into North America than is currently supposed, for signs of their journeys in the form of inscribed stones and Viking weapons are reported almost from the heart of the continent The "Kensington Stone," from Western Minnesota, has an inscription in Gothic Runes to the effect that in 1362 eight Swedes and twenty two Norwegians made an exploration from Wineland to the west The 'Blond Eskimos' of the Coppermine River, and the blue-eyed Mandan Amerinds of North Dakota may preserve traces of Viking ancestors *

We may reconstruct the migrations into America on the lines of those into the other "world peninsulas" No doubt the first-comers would be primitive tribes few in numbers and not likely to resist the onslaught of the later hordes We have seen that most of the Negroid peoples in the Old World seem to have been driven towards the equatorial regions where the hot environment no doubt tended to prevent the Negro from evolving into something higher From this point of view we should hardly expect that the most primitive peoples would be present in large numbers in the *north east* of Asia, which was the 'jumping-off place' for American migrations At any rate, (if we except the Los Angeles skeletons) the most primitive skeletons in America appear to be like those of Lagoa Santa (in East Brazil), marked by dolichocephaly and short stature Middens in this region contain similar later skulls Moreover, the hair of living Amerinds, such as the Karayas of Matto Grosso (C I 73), the Bakairas (of the Xingu River), and some Arawaks, is often wavy or frizzy according to Deniker So also are some Fuegians Sullivan, in his report on the Punin cranium, says, "Either we have in certain parts of America skeletal remains of a type basically related to those found also in Australia and Melanesia or we have a remarkable case of parallelism" * This certainly indicates the presence in the far past of Negroid peoples in the American continent

Among these primitive tribes the Botocudo are of interest They dwell in the mountains about 200 miles north of Rio de Janeiro They are of low stature (1 590 mm) with a head index about 76

*R. Hennig in *Zeitschrift für Rassenkunde* 1937 pp 20-8

*Sullivan and Hellman *The Punin Calvarium* (New York American Museum of Natural History 1925)

Their skulls according to Deniker, are very like those of the prehistoric peoples of Lagoa Santa, and their features resemble those of the Fuegians. The brow ridge is prominent and the sunken nose is narrow at the root. We may be sure that a fairly large migration of these primitive peoples whose anthropometry recalls that of the Australians and Ainu entered America far back in the history of man.

Skulls of a similar type from Bogota, Coronel, and Patagonia, described by Verneau⁷ and others, probably represent descendants of early Australoid migrations. The Qurungua type described by Wegner⁸ from lower Bolivia is probably a living representative of such an early migration. A glance at the features given in Plate II (at 24) shows heavy brows, deep nasal notch, broad nose, and large prognathous jaws. These are all absent in typical Amerinds, but characterize Australoid peoples.

Of distinctly higher type would seem to be the Eskimo peoples, who represent probably some of the earliest inhabitants of North America. They appear to mix readily with neighbouring peoples, hence we may assume that the more remote eastern Eskimo were purer than the western, at any rate until the Danish settlers arrived. The Greenlanders appear to have longer heads and less stature than the tribes to the west. According to Deniker, the eyes are straight set and black, the nose is rather prominent, the face round, and the mouth rather thick lipped. Jenness compares some rarer types to the "Melanesian," which seems to show that some strain of Negroid blood is present, but definite physical evidence is at present lacking.

I have mentioned in an earlier section that their culture is notably like that of the upper Palaeolithic folk of France, while the disharmonic skull (long head and somewhat broad face) recalls that of the Cro Magnon type at that date. These data suggest that the first migration into America may well have been of a Botocudo or Australoid type (the Palaeo Amerind), followed by an Eskimo migration with an Aurignacian culture. This is, of course, just the succession in Europe—that western peninsula of Asia—and is due to the changing climatic controls. It is possible that the same controls may have led to the same migrations entering the "eastern peninsula" which we call America. We know that many Asiatic animals entered North America towards the close of the Pleistocene, and nothing is more likely than that the Asiatic races accompanied their usual prey.

⁷ *Cranes d Indiens de la Colombia* (*Anthropologie* Paris 1924)

⁸ *Zum Sonnenlor durch Altes Indsianerland* (Darmstadt, 1931)

Following these primitive peoples came great hordes of dokeph peoples of which there were probably many migrations. They entered America probably in the Azilian times which succeeded the last Great Ice Age. Climates seem to have been warmer than now. It is possible that the Bering Straits had not developed, so that the cold Polar current was absent also. In this case a broad "corridor," with a climate in summer like that of Scotland, would tempt the Asiatic peoples to cross. Moreover, there was no doubt pressure on the south from the developing Alpine peoples in Central Asia.

One can, therefore picture a 'stampede' of peoples into this glorious region of America, where the country improved in climate and food supply the farther they moved to the south. Only a few helpless Australoids would flit through the woods ahead of them, for we may imagine the Eskimo keeping to the north in the environment to which he had become accustomed.

Thus occurred the entry of the groups of Mediterranean race who now occupy Brazil, such as the Ges, Tupi and Arawak races. In the north there spread out to the east the Algonkian and Athapascan races although these have certainly been altered by later contacts. The great American 'corridor' seems to have been along the foot hills of the Rockies and Andean Ranges, between the rugged mountains and the thick forests of the Eastern United States, or the thicker selvas of the Amazon. These folk are in many ways akin to those of Western Europe and to the lower Polynesian races, as I have explained in an earlier chapter.

The fourth group of peoples were the brakeph races with head indexes from 82 to 88 i e., Haddon's Neo-Amerinds. They seem to have moved along the western plateau of America right down into Patagonia where they are typically represented. They have, indeed, made but two important incursions from the main corridor. The first is the great Shoshone-Muskogean migration, which has taken brakeph Amerinds to Florida and Lake Michigan. The second is the Carib incursion along the north coast of South America.

The last migrations have apparently been by far the most violent. They have found the world already occupied by more or less settled tribes and in consequence a tremendous clashing and breaking up of races has occurred. This is especially marked in those regions for which I suggest the name *Shatter Belts*. The main line of disruption occurs all along the great corridor from the Malayan region through China, Eastern Siberia, and the western coast of America. Here the

debris of primitive tribes is scattered like scum left by a great wave. Down the coast of British Columbia and California are four times as many distinct tribes as in the rest of North America. The small *dokeph* tribes of California have been pushed to the west by the stronger *brakeph* folk. The important tribes of Athapascans of New Mexico are long heads as are also many of the Piman tribes of Mexico (see Fig. 92).

Probably each of these shattered American tribes has a counterpart in the broader territory of the eastern peoples. We know that this is true of the Athapascans of Oregon and of the northern plains. It is highly probable that the Salishan folk were originally connected with some of the (Sioux?) tribes of Iowa and Dakota. The Seri (76) of the Gulf of California have survived very remarkably, and the congeners of these Mediterranean people will probably be found in the extinct Hurons of the far east or possibly in the Tupi-Guarani people of South America. Similarly we get Pano (in the Huallaga and Marañon Basins) in the north and Yahgan in the south of South America, Bororo in Matto Grosso and Tehuelche in Patagonia as probable disrupted pairs in the southern continent.

In South America there is another *shatter belt*, where the more primitive tribes are driven down against the impenetrable forests of Brazil from their old highland homes. A crescentic belt of mingled tribes is shown by Chamberlain in his ethnological map of South America. It starts in Colombia between the Chibcha and Carib regions. It continues southward between the Aymara and Arawak (forest) tribes. It curves round to the east about the Tapuyan tribes of Eastern Brazil.

Two significant features are apparent in the distribution of peoples described above. The first is the association of short rather dark somewhat platyrrhine peoples with a tropical environment. These tribes are rather less broad-headed than the majority of the Amerinds. Their position *across* the main corridor into South America may imply that here there took place a degeneration of higher types, though I do not think this likely. Alternatively there may have been a movement away from such regions (consequent on a change of climate) on the part of the more *brakeph* peoples. We may note, however, that many *brakephs* occur here also, such as the Yucatecs of Mexico. It is however, noticeable that the founders of the great Maya civilization of Central America were *brakephs* and that the Aztecs, who were long-headed, were certainly later invaders from the north.

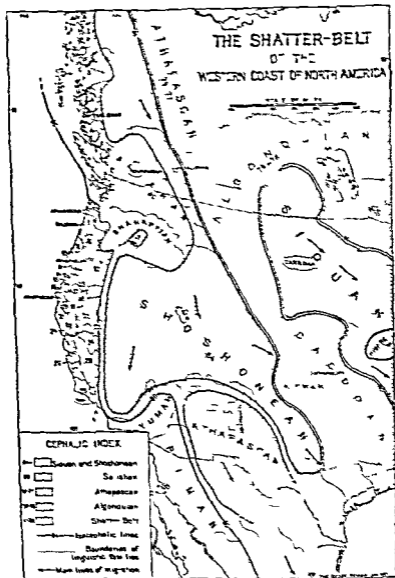


FIGURE 92.—Tribal distribution in Western North America. (Based on J. W. Powell's map in the United States Census, 1915.) Notice the Algonquian tribes disrupted by later migration of Siouan and Shoshonean.

The second noteworthy feature is the isolation of groups of extremely brachep tribes, far removed from each other and from their homologues in Asia. Among these are the Plains Indians (88) of the central Mississippi Valley and some of the Peruvian Indians (88). Possibly head deformation may account for these hyper brachep tribes, but it may be a case of local evolution due to an unusually stimulating environment. Differentiation of these peoples seems less likely than among many tribes in the Old World, since the former have only lived for a few thousand years in America. Yet it is certain that evolution is progressing among all of us, the rate depending chiefly perhaps on the total stimuli (cultural or climatic) to which the group is subjected. Here again we must await local research.

MIGRATION AND CULTURE IN AMERICA

*(Mainly after Wissler)**(Strata, with the earliest at the bottom)*

	<i>North Hunting area</i>	<i>North West</i>	<i>Mexico etc</i>	<i>Manioc</i>
A.D. 1500 Cities (in centre)	Slat armour Sinew bow	Copper	Artec Bronze	Curare
B.C. 0	Dog traction Pit house	Mounds Hoes	Maya Megaliths	Blow-gun Hammock
ARCHAIC PERIOD				
Agriculture		Tobacco Maize		Manioc
B.C. 6000 Hunting	Dog	Stone polishing Bow	Canoe Harpoon and spear thrower	Net
B.C. 15 000	MAIN INFILTRATION			
B.C. 50 000?	Folsom type of culture? Punin and other primitive Australoid peoples.			

It seems almost certain that much of Amerind culture has developed since the Amerinds reached America. The above table gives in a tentative fashion the development of culture, based on the work of Wissler, Nelson, and others. Before the Wurm Ice Age, it seems

likely to the writer that there were Australoids in America. Possibly the Folsom culture may go back to these people. It is far older than other types and perhaps dates back to a time when Arctic animals lived in the Central United States.

The normal Amerinds came into America about B.C. 15,000, and were in the hunting stage of culture. They used bows, nets and canoes and had tamed the dog. This stage of culture all over America is shown in Fig. 93. Gradually crops were grown and became the

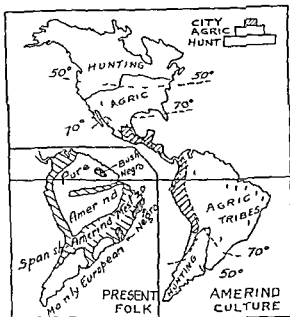


FIGURE 93—Primitive culture in America to show its distribution (in zones and strata) (After Wissler). Inset is a map showing the present distribution of cultures, i.e. cultural groups.

main support of a group of Amerinds who naturally lived in the more attractive and warmer parts of the continent. Maize and manioc were two of their many discoveries in agriculture. Finally during the last two millennia the peoples of Central America and the plateaux began to dwell in towns and gradually developed the city states of the Mayas, Incas, Aztecs and modern Pueblo peoples. To the geographer the chief interest is that this development illustrates

clearly the Zones and Strata principle (Fig 93) The hunting stage was the oldest and spread farthest The city stage was the last, it developed in the *cradle land* of Amerind culture and constitutes the latest cultural stratum

Today South America offers the best laboratory for testing race mixtures The southern states are the most progressive, and are colonized most largely by European settlers (Fig 93, inset) Yet we must not neglect the climatic factor The northern states (Ecuador, Venezuela, etc) may be less progressive, primarily because their climate varies little, and in large areas is too hot to permit of energetic development It is worth remembering that Lord Bryce states that "the Chilean peasant to-day, who is at least half Indian, is not inferior to the Argentine peasant, who is almost pure white"⁹

In the warmer coastlands of South America the Mestizo is dominant, while in the Amazon forests no one lives except widely scattered Amerinds In the east are considerable numbers of Negroes, but they have all originally come from Africa as slaves (Fig 93, inset)

Early Migrations into the United States (Map on p 251)

J McGregor (1941) has summarized the evidence for early migrations into the Southern States At Lake Bonneville (Utah) early man was here when the level of the Salt Lake was 900 feet higher At Gypsum Lake (Nevada) human hearths were found below fossil sloths Folsom arrowheads were found under 18 feet of overburden at Lindenmeier (Colo) In Arizona skeletons in the south probably date back to 13 000 B C In New Mexico is the classic site at Folsom, with Folsom arrowheads and extinct bison while at Brunet (polar) muskox bones were found with Folsom flints In Texas near Abilene Leighton found artifacts which he dates 70,000 B C Near Beeville (Texas) are Pleistocene fossils (elephant and sloth) with flint artifacts which may be 75 000 years old At Sauk (Minnesota) a fossil skull was found with features resembling Neandertal Man It is possible that many of these data are linked with an early Australoid migration akin in type to Qurungua Man (page 257)

⁹*South America* (New York 1913)

CHAPTER XXI

THE MIGRATION ZONE THEORY OF RACE EVOLUTION

A Evidence from the Strata

In the preceding chapters we have discussed the world plan and the zoning of the races which inhabit the various continents. The evidence so far accumulated may be summed up in eight propositions and principles somewhat as follows:

- I The great land masses consist of a central continent (Asia) with three peninsulas —Eur Africa Australasia and America
- II Each peninsula contains zones of peoples which are more and more primitive as we move away from Asia (see Frontis piece)
- III *First Principle of Race Evolution* The most primitive races are found pushed to the periphery i.e. in Tasmania Cape Colony Greenland and Brazil
- IV *Second Principle of Race Evolution* The last evolved races are found in the centre where stimuli leading to evolution have been greatest throughout the ages
- V *Third Principle of Race Evolution* Where the racial evolution has progressed farthest the buried strata of more primitive tribes will be most numerous (This buried evidence includes skeletons artefacts place names folk lore etc.)
- VI *Fourth Principle of Race Evolution* The order of evolution is the same whether we move outwards from the centre of evolution across the zones or downwards at the centre of evolution through the strata
- VII It follows that the primitive races are found alive precisely where they did *not* originate
- VIII The evidence in Europe Africa Southern Asia and Australasia shows an age long *centrifugal movement* from Central Asia (Turkestan or thereabouts). American evidence is more complex but of the same kind

We may however examine here further evidence as to the validity of the Third Principle mentioned above. This involves a general study of the strata throughout the world.

In Europe *Neanderthal* man is certainly the earliest race of which we have sufficient relics to deduce a fairly abundant population. He is found fairly generally through Southern Western, and Central Europe. Nowhere else have ethnological investigations been carried on systematically, but the presence of the more or less similar Neanderthal or Proto Australian skulls or skeletons in Galilee, Cape

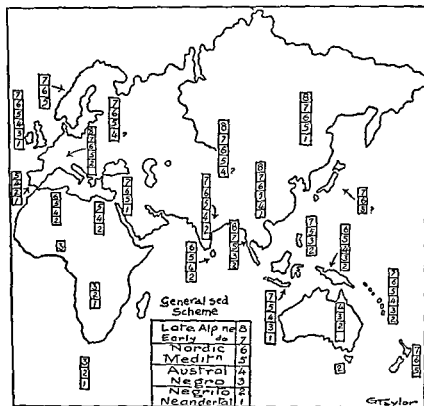


FIGURE 94—Racial strata showing Order of Evolution—generalized

town, Rhodesia, China, Java, and New South Wales shows that he must have ranged over the whole of the Old World except perhaps the cold northern portions (see p 227). We may therefore label this race, always associated with early Palaeolithic artefacts, as Stratum 1 in our survey of the old World (see Fig 94).

Next in order in Europe would seem to be the *Negrito* race, of which more and more evidence is accumulating every year. We may

call it Stratum 2 and it appears in plan in the lowest map of Fig 95. Artefacts of Aurignacian type are commonly associated with this race. We may not agree that similar Aurignacian tools and drawings elsewhere always indicate the presence of a Negrito race, but indeed the living types are very widely spread peoples, so that they may well have introduced this type of culture all over the world. They are often the earliest races, as we may deduce from their invariable position in the inland inaccessible portions, or in the marginal islands, of the territory which they share with other folk. Their artefacts and drawings have been found in an uninterrupted belt from Europe to southernmost Africa. Drawings of a similar nature are also found at Raigarh in Central India.¹

In the map they are seen to be the sole people to have reached Tasmania; they are the lowest stratum all through the East Indies and Melanesia and also in India. But later research will doubtless find Neanderthal man, or even earlier ape man, in many places where the Negritos now seem to be the earliest peoples.

As regards later living types, the writer believes that more and more of the generalized skeletons linking the Neanderthal, Negro, and Australoid races will be excavated. However, for reasons stated earlier (p 98) he believes that the Negro evolved earlier than the Australoid.

We may therefore label the third stratum *Negroid*. These people must have been quite abundant in Europe towards the close of the Palaeolithic. Boule quotes their skeletons from Brittany, Switzerland, Liguria, Lombardy, Illyria and Bulgaria. They are universal through Africa and through Melanesia, while the Botocudo and the Lagoa Santa skulls of East Brazil show where similar folk penetrated to the New World. A Mousterian station near Krasnoïarsk in Siberia, associated with the mammoth, probably shows the presence of this Neanderthal Negro Australoid type in North Asia.²

The fourth stratum which is almost world wide, and which probably extends to America, is the *Australoid* (Fig 95 at C). It is, of course, universal through Australia, Indonesia, south east Asia, and South India. Types akin to the Australian were common in early Palaeolithic times in Europe. It is, however, difficult to decide whether some early peoples were more like Australians or Africans (Negro). Indeed one skull from Mugem (Portugal) is described as

¹*Prehistoric India op cit*

²Boule *Fossil Man* (Edinburgh 1923)

"Negroid and Australian" As regards Australia itself, Dixon comments on the African affinities of the Australian aboriginal

The Cro Magnon folk of upper Palaeolithic times belong to an early level in the Mediterranean stratum (5) Their broad faces and narrow skulls are found in the Canary Isles in North Africa and among the Eskimo of Greenland Many of the earlier Amerinds also probably contain much Cro Magnon blood, and no doubt many other races—possibly the Yenesei Ostiaks—are kinsfolk (Fig 44)

As regards the main Mediterranean stratum, it is universal except in those peripheral portions of the world where the more primitive Negroid peoples still hold their own The chief point of interest is that these peoples once occupied almost all the territory which is now Alpine (or held by the allied Mongolian) They seem to have been the great megalith builders, and they carried the late Palaeolithic and early Neolithic civilization all over the world This happened long before the Egyptians settled down to mercantile and city life, in the opinion of the writer Hence we find many features akin to Egyptian culture, which had a common Asiatic ancestry with the latter, but was in no sense directly derived from Egypt (Fig 43)

All through Siberia, Manchuria, and Mongolia are innumerable artefacts mostly Neolithic, but as Boule remarks³ this culture is here less clearly separated from the Palaeolithic than in Europe This seems to the writer to indicate the *gradual growth* in the original Asiatic homeland of Neolithic civilization, as opposed to the fairly sharp break found in Europe when Asiatic newcomers brought in the Neolithic culture

The Nordic stratum which I have labelled (6) is perhaps a specialized upper zone of the Mediterranean It occurs typically in north west Europe but Proto Nordic types characterized by very hairy bodies are found sporadically from Turkestan to Northern Japan Biasutti in his atlas⁴ shows on Plate II that *blond* peoples are found throughout the square block whose margins are Iceland, the Yenesei River, Lob Nor (Tarim Basin), Laristan (Southern Persia), and the Atlas Mountains (Morocco)

The two latest strata are Alpine or Mongolian They are the most abundant of living races, but have by no means the widest range in man's history, if we realize that the earlier strata (Nordic Mediterranean, and Nesiot) are still represented 'beneath' the Alpine

³*Ibid*

⁴*Op cit*

aces Thus near Lake Baikal in the heart of brachycephalic Asia there have been found ancient narrow skulls and the same is true of the Kurgans (mounds) of Siberia which are certainly Proto-Nordic in type In fact the overwhelming of dokeph peoples by brakeph invasions is the salient feature of later ethnological history

The four races so far discussed and their respective migrations are represented in the stage-diagram given in Fig 95 Here the *black* areas show present habitats while *dotted* areas show probable early habitats The oldest race is shown at the bottom Let us now consider the latest and best known distribution It is that of the Alpine race shown at *E* Here is a solid block of brakephs who have unfortunately been divided in some text books into two races Caucasians and Mongolians for reasons which seem insufficient to the writer (see p 206) It is true there are obvious facial differences between a slant-eyed Mongolian and a European Swiss But slant eyes occur among other races and are not there made a major criterion Cheek bones are more prominent in parts of Scotland than in much of Mongolia It is impossible to draw a satisfactory line of division between the European Alpines and the Asiatic Mongolians The people of Turkestan exhibit both kinds of Alpine race—so that to the writer their averages may be taken as the original type from which we have European and Mongolian variants

It is of interest to see how exactly the belt of the broadest headed folk (over 83) occupies the centre of the zones Apart from the aberrant Negritoes there is a universal increase of head breadth as we move from the margin to the centre of the zones If we adhere to the Age and Area (or Zones and Strata) hypothesis we are driven to the conclusion that the general evolution of the human race has been in the direction of broader and broader heads If we accept that the centre of the zones contains the latest evolved types then this belt of hyper brakephs (extending from Switzerland to Korea) contains the last evolved of the human races It is hardly necessary to point out that this evolution probably occurred more than twenty thousand years ago—and that the *present* mental moral and material status of the Turkomans is not of the slightest importance in our discussion It may however be mentioned that there is much evidence that the environment of Turkestan was much more attractive even so lately as B C 500 than it is now It has been on the whole drying up ever since that date

The second feature to note about the Alpine distribution is that it

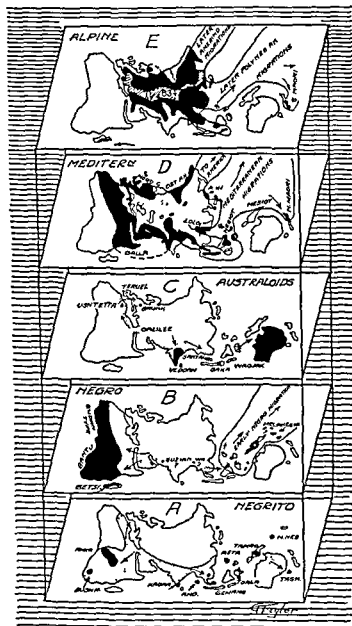


FIGURE 95—A stage-diagram showing the five stages in racial migrations in the Old World each representing a separate major race. Black areas show present habitats. Dotted areas are probable early habitats. The lowest race in the diagram was the first differentiated, the highest was the latest.

reaches the coast of the Pacific—but does not border any of the other oceans at all notably This would seem to indicate that the "Alpine Focus" was nearer or more accessible to the Pacific than to the Arctic, Indian or Atlantic coasts This is due to the topography The great barrier called the "Alpine Storm" (a series of lately formed high mountains) extends from Spain to China with hardly a break North of that lie broad plains for the most part—which facilitate east west movements Yet farther to the north we have the 'Cold Death Deserts' of the tundra which shut off Alpine expansion during most of its race history (Fig 77)

The distribution therefore would lead us to assume a point midway from France to China as the probable centre of Alpine expansion There can be no doubt that somewhere near Turkestan this focus was situated Early European history deals with influxes of *brakephs* *via* Anatolia The Russian steppes have been attacked continuously since the dawn of history by nomads from the Asiatic plains The history of the Near East is filled with invasions from the north and north east (only rarely are there large tribal movements from the south) India has always been invaded from the north west Early Chinese history is a record of invasions by the Jade Gate *i.e.*, from the north west All these corridors of migration lead back to one centre—near the Caspian and Aral Seas As the writer has pointed out all recorded history can be summarized in five words 'The Thrusts of the Alpines' (Fig 80)

Since the Alpine race is bounded in the east by the ocean, we should expect to find some of the earlier Alpines and most of the marginal zone of the next preceding race thrust out to the islands of the Pacific This is abundantly true for Alpines are found throughout Polynesia Moreover during the last few thousand years there have been long periods when conditions were probably warmer than today in the Old World Thus in Azilian times and later—say from B.C. 8000 to B.C. 5000—Europe at times was warmer than now By analogy north east Siberia and the Bering Straits may have had a climate much more attractive than it is now This period probably saw vast hordes of earlier Alpines pouring into Alaska and nearby American lands as they were thrust onward by the expansions of later Alpines in Asia (Fig 44)

A brief consideration of the 'Transport analogy' (p 45) will show us that these bordering Alpines (thrust into the Pacific and into America) should resemble in general the similarly situated borderland

Alpines in Europe This is indeed the case The Amerinds and higher Polynesians are everywhere described by laymen as peculiarly "European looking" In other words, they represent the same early stage of Alpine development as do the European Alpines—and do not exhibit so generally the Mongolian eye folds, cheek-bones, etc., as do the Alpines of Eastern Asia

It is especially important to note that the Alpines of today are everywhere the *latest comers* They are the "top stratum," and by the law of "geological superposition" they are the last evolved Perhaps because much comparative anthropology has been either Nordic or German, this conclusion does not appear to have been published before the writer's memoir in 1919 The past accomplishments of the Alpines have perhaps not quite equalled those of the Nordics during the meagre eight hundred years or so of the record of North European history But, as regards the future, any student of race should be interested by the fact that Russia controls most of the Alpine habitat of today

The "ethnological record" as expressed by these strata is very like the geological record It is very incomplete, but the order of succession is practically the same throughout We see that the latest stratum (8) occurs only across the centre in the Old World Here the greatest number of superposed strata will undoubtedly be found when enough ethnologists seriously attack the problem in Central Asia Just as the geological record incorporates the history of the evolution of life, so the ethnological record must contain the history of racial evolution I can see no escape from the conclusion that the Alpine Mongolian is the latest type of man which has been developed from a type not unlike the Mediterranean race (Fig 94)

It should be specially noted in Fig 95 that the connexion between the Negrito and the Alpine people is very remote If, as Dixon suggests, Negritoes developed into the Alpines, we should expect to find a zone of broad headed hybrids between the Negritoes and Alpines The contrary is the case the Negritoes (whether broad headed as in Asia, or comparatively narrow headed as in Africa) are found as isolated groups among large numbers of dokeph peoples This is true in southern Australia, in Papua, and Melanesia, in the Malay States, in Central Africa, and in South Africa Hence, I think that the simplest explanation is that the ancestors of the Negrito and Neanderthal types developed independently from the primitive Catarrhine ape stock, in Pliocene or even Miocene times They lived side by side

in Asia until the immense climatic changes of the Pleistocene greatly quickened evolution. Whether the Negro and later races developed in Asia from a Neanderthaloid man as seems probable to the writer, or whether there was a third "Proto Cro-Magnon" type must be left to the future to decide.

B *The Mechanism of the Migrations*

It is obvious that any explanation of the causes of the racial migrations must be largely speculative. But such speculations, if based on the scientific truths already accumulated, are often of great value in suggesting the proper lines of attack in further research. In the preceding chapters I have demonstrated a zonal distribution of the four major races of man about Central Asia. These four races are the Negrito, the Negro, the Mediterranean, and the Alpine-Mongolian races.

We must seek therefore, in the centre of the Old World for some great stimulus competent to produce such remarkable changes as those which distinguish the Negro from the Northern Chinese or Swiss Alpine peoples.

It will be well at this point to turn back to the useful parallel furnished in the Evolution of Transport (Fig. 20). Here the "zones of vehicles" were arranged around Sydney in a definite order—that of their "evolution." So also the strata beneath the centre of origin preserved the same order of evolution in "fossil" form.

We see then that the zones and strata of the various "vehicles" depend on successive migrations from a common centre. At this common centre the brains and commercial enterprise of the community were concentrated, so that here the evolution of transport progressed most rapidly.

What corresponds to the "enterprise of the metropolitan community" in our fundamental ethnical problem? Surely a great change in the human environment would lead to precisely those zones and strata which we see in the racial map.

The solution of the problem seems near at hand when we find that in the centre of the Old World we have not only the greatest range of climate during the year but also the greatest variation in climate during the period of man's life on the earth.

The Great Ice Ages in Europe without doubt obtained in Asia also, though owing to the distance of Central Asia from the sea and the absence of highlands in North Asia, it seems certain that North Asia

was not universally covered with ice-caps such as occurred in North America and North-West Europe. Antevs in his recent book *The Last Glaciation*⁵ states that most of Asia north of 62° N. was heavily glaciated, although it is nearly at sea-level. This includes a belt along the Arctic Ocean, perhaps 300 miles wide, which is now occupied with tundra (Fig. 77).

All the highlands of Siberia were also covered with ice. In south-west China, in the Yung-Ling Mountains, the snow-line is now at 18,050 feet, but in the Pleistocene it was 4,600 feet lower. In the Himalayas four separate Ice Ages have been identified, so that we may conclude that the variations in Asia were similar in kind and degree to those of Europe.

I have discussed in considerable detail what seems to me a reasonable "working hypothesis" of racial evolution in my article on "Evolution of Race and Culture,"⁶ but I will repeat the gist of the thesis here.

In the first place the migrations were probably extremely slow, and were made quite unwittingly by the primitive peoples concerned. They would all be hunters, preying on wild animals or upon wild fruits and grains. With the onset of any Ice Age, the forests, steppes, and tundras move slowly but *en masse* to the south. A fall of temperature of 12° F. is the maximum effect. This temperature range (by the ordinary ratio explained in any text-book of climatology)⁷ is normally equivalent to a journey of some 800 miles toward the Pole. Such a migration of vegetation would perhaps change half the Siberian forest into tundra, and change the whole central Asiatic desert belt into steppe, while much of the southern forest belt would gradually turn into desert.

Research in Scandinavia has made it much easier for us to reconstruct the movement of ice-caps, vegetation zones, and of man himself. De Geer and others working on the Varve-clays have dated the moraine of the waning Wurm Ice Age as it developed in South Sweden. They place it about B.C. 18,500. This is shown in Fig. 96—where Sweden is shown buried under the great ice-cap. Peat bogs in North Germany and Denmark show that tundra plants were growing south of the ice-cap at this time. Man had apparently not yet appeared in Sweden.

⁵New York, 1928.

⁶In *Geographical Review*, 1921.

⁷Off China the world isotherms change 1° F. for about 1° of latitude.

In block-diagram *B* (Fig 96) we see that the ice front has retreated half way along the Swedish Peninsula. This is dated about B.C. 9000. At that time the peat bogs in Germany show remains of fir trees, and here also we find the artefacts of Neolithic man. Apparently Palaeolithic man found the tundra and steppe very unattractive and so never settled on the Baltic. The next diagram *C* shows us a further retreat during 5 000 years. The fir now covers Southern Scandinavia and oak trees cover Northern Germany. Bronze tools are found in the bogs in the oak stratum—showing that a higher culture has moved

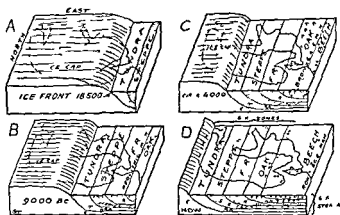


FIGURE 96—Block-diagrams showing the northward march of the ice-cap, the vegetation zones and primitive man in Scandinavia since the close of the Wurm Ice Age. The front of each diagram shows the strata in section. (Based on research by De Geer, Peake, Fleure and others.)

north with the ice retreat. Finally, at the dawn of history, conditions were like those today. The beech is now the dominant tree on the Baltic—and its advent was marked by the coming of Iron Age man. Here then we have a *dated* set of zones and strata, and we can be sure that similar movements of vegetation and man northward and southward accompanied every one of the Ice Ages throughout the Pleistocene. This diagram is one of the most important in the book.

The conditions which obtained near the cradle land are suggested in the following hypothesis. The area in Fig 97 is *East Asia*, because the topographic controls are much more complex south of Turkestan. Primitive man probably developed in Asia on the borders of the warm steppes and wood lands. He would certainly migrate south to what

are now tropical regions as all his food-supply moved south, before the cold wave. After many thousand years the cold conditions would slowly pass away. The flora and fauna would move back to the north. A large part of the human race would probably go back also; but it seems a logical conclusion that some tribes would remain, in spite of the increasing heat and the changing environment, for reasons given on page 99. Here we find the key to the first racial differentiation. Those tribes which remained in the tropic environment *stagnated*. There was no climatic stimulus, and no invigorating change of seasons

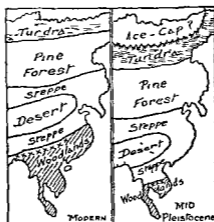


FIGURE 97.—Hypothetical diagram of East Asia, showing movement of vegetation belts consequent on about 12° fall in temperature. Crosses show the most favourable habitat of primitive man. (Compare Fig. 77.)

during all the hundred thousand years of the ensuing interglacial period. In effect primitive man is here preserved right down to modern times.

Meanwhile, the tribes migrating northward back to the inland regions would be subjected to a very different environment during the *Interglacial* period. Here the primitive race in the course of one hundred thousand years evolved into a higher race. Another Ice Age commences and the same phenomena are repeated. This second race (*B*) migrates south. It probably now consists of much larger tribes, which have little difficulty in driving the unprogressive and unchanged portion of race (*A*) farther into the tropics, and ultimately into the islands south of Asia (Fig. 97).

Again the Ice Age passes away, and race (*B*) in large part returns,

leaving however race (A) and part of race (B) as stagnant zones to the south of the Asiatic land mass and so the process goes on

It is not possible at this stage to correlate the evolution of the major races with the Great Ice Ages but it would seem that four great stimuli had produced four great and cumulative differentiations. But I have not to date read any other definite account which purports to explain what determined racial evolution and how the migrations occurred so that I trust this theory which correlates the accepted facts of zones of peoples with the four climatic thrusts will receive due consideration

I have discussed in an earlier chapter the relations between European and Asiatic prehistory. If man first appears in Europe in the Second Interglacial (as some authorities suggest) it seems likely that he moved out of Central Asia many millennia earlier, and that he spent the intervening time in crossing Western Asia and Africa. It seems possible that both the Negritoes and Neanderthal man occupied Asia during the Mindel Ice Age. Perhaps the Negritoes migrated as the result of this climatic thrust and never returned to the 'Region of Maximum Evolution'

Neanderthal (Mousterian) man may have moved out after the Second Ice Age and reached Europe about the time of the Third Ice Age. He was the chief inhabitant of Europe during the Riss Wurm (or Third) Interglacial. But during this time one may postulate that the allied Negroid or Australoid folk in Asia were evolving into the Mediterranean peoples (Fig. 98)

The Third Ice Age drove many of the earliest Mediterranean peoples out of Asia and they appear in Europe as the Cro Magnons and their allies just before the last Ice Age. The fourth climatic thrust is perhaps responsible for the migrations of many later Mediterraneans and of the early Alpine Mongolians who appear in Europe (in Olney and elsewhere) in Azilian times after the last Ice Age had passed away. The result of these alternating periods of evolution and migration is that the races of man have become arranged in a series of somewhat complicated zones about Central Asia. This is illustrated in the Frontispiece and is the basis of the scheme of classification given in the table on page 65

C *Keith's Hormone Theory*

The necessary climatic stimulus acting upon the plastic human organism would thus seem to be discovered. We know that evolution

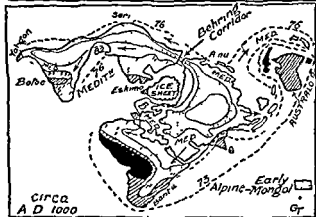
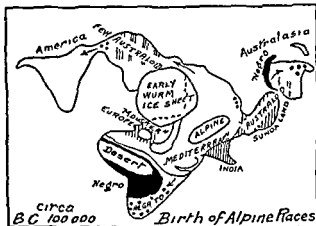
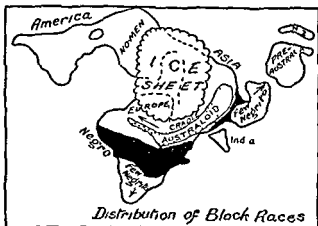


FIGURE 98.—Generalized maps indicating the outward march of the migrations from Asia (For intermediate maps see *Geographical Review* Jan., 1921, and see also the Frontispiece herewith)

has occurred along the lines indicated by the change from the long headed curly haired platyrrhine Negro to the broad headed straight haired leptorrhine Alpine. What has been the physiological agent which has moulded man? The research and discussions of Sir Arthur Keith have I think indicated the method used by nature.

Sir Arthur Keith⁸ points out that many of the criteria used by ethnologists have been definitely proved to be affected by various glands in the body. Of these the chief are the pituitary and pineal glands within the cranium, the thyroid gland in the throat and the adrenal glands near the kidneys. Abnormal growth of the pituitary glands leads to the development of a large chin, nose and brow. These features of course characterize the Neanderthal peoples. Furthermore in European folk the nose and chin are normally larger than usual in man, perhaps as a result of slight stimulation of the pituitary. The adrenals affect the colour of the skin and it may be that the original black colour of primitive man has varied in accord with changes in the adrenals.

A poorly developed thyroid leads to stunted growth, to undeveloped nose and hair and to a flat face. These are characteristic of some of the so called Mongolian peoples (though not of the most progressive races of Central and East Asia) and it is possible that decrease in thyroid has affected the people of East Asia as a whole.

So also the Hottentot and Bushman differ from the Negro along lines which might be explained in part by deficiency of thyroid.

The adrenal further controls sex characters such as hairiness of the face and body. These are characteristic of European and Australian people whereas the Negro and Mongolian folk are perhaps immature in this respect. It is however important to note that Sir Arthur Keith specifically describes the Mongolian race as one of the most recently evolved.

Speaking generally a rather moist warm climate probably constituted man's early environment. The change to a moist cooler climate in the Central Asiatic region may have stimulated one set of glands and hormones⁹ and so brought about the changes in facial and bodily form which distinguish the Mediterranean from the Negro. Further changes during the long ages spent by man in the same

⁸ "Evolution of Human Races in the Light of the Hormone Theory" (*Johns Hopkins Bulletin* 1922)

⁹ Hormones are chemical substances secreted by the glands which greatly affect human characteristics.

locality seem to have been in the direction of aridity, this may have affected other glands and hormones and so developed the stocky, broad faced straight haired Alpine and Mongolian peoples. Change of food may also have been a factor. But this physiological aspect of the problem is one which I am not competent to discuss at all fully.

We must remember that in all probability these racial traits were determined in the million years spent by the developing stocks in Central Asia. It is the climatic changes *here* which are all important. Most races (excluding perhaps the Negroes and Negritoes) spent, shall we say, nine tenths of their biological life in Asia and only one tenth in the habitats where we now find them. It is this which makes references to *present day* environments as factors in racial evolution and racial status, appear of little value to the present writer as regards most races. On the other hand, present day environment is, of course, the most potent factor in the *material* status of a people.

D *Biological Confirmation*

All these migrations, and indeed the evolution and differentiation of the races, took place far back in the prehistory of man, when he was almost entirely controlled by the same natural forces as dominate the brute creation. We should, therefore, expect to see something of the same phenomena in the evolution of the higher mammals. In that most stimulating work *Climate and Evolution*,¹⁰ W. D. Matthew shows that this is the case. (Indeed, he goes farther and indicates what must be the general principles governing human evolution also.)

We may consider the evidence as regards the evolution of the tapir, rhinoceros, and horse. These all belong to one family of Perissodactyl mammals, and the general trend of evolution is from the tapir to the rhinoceros and thence up to the horse. For example, the tapir has *four* of the original five toes, the rhinoceros *three*, and the horse only *one*. The horse evolved in response to the changing environment (which no longer suited the jungle loving rhinoceros) from a *more plastic* intermediate form. In our problem it is the distribution with its illuminating zones and strata, which is of interest. We find that the tapir occurs living in South America and the East Indies. This would almost necessitate two centres of evolution according to the *old theories* of biology, just as some ethnologists, for similar reasons, still suggest these two regions as likely cradle lands of the human race.

¹⁰*Op cit*

The rhinoceros is found in South Africa and in India. In the last geological epoch (Pleistocene) the rhinoceros lived in North America also (Fig 99)

The natural habitat of the horse includes the centres of the Old World and North America. In common with many high types of animal, the horse vanished from America in late Tertiary times perhaps owing to diseases due to trypanosomes.

We have here therefore, three zones arranged about Asia in the order of evolution. The fossil evidence in the Old World shows the



FIGURE 99—Three all ed mammals are arranged in order of their evolution about the centre of Asia. T, R, and H are the centres of dispersion for tapir, rhinoceros and horse. (From a map by W. D. Matthew.)

horse stratum over the fossil rhinoceros stratum and the fossil tapir stratum below both. If for the horses we substitute Alpine man who has much the same habitat and for the tapir in the outer portions of the earth the Negro we see that the analogy is so complete as to be almost uncontrovertible that the Alpine Mongolian type is a higher form than the Mediterranean but is probably descended from some type akin to the Mediterranean. Matthew in the same memoir gives charts for the even toed mammals and shows that the evolution and cradle land of the antelope, ox and sheep can be demonstrated in the same way from the distribution.

The biological evidence is also very suggestive as to the birth place of man. We find in Tertiary times considerable evidence of a change of climate. In early Tertiary times there was a fairly uniform warm climate in mid latitudes in the Old World. This was possibly partly

due to considerable changes in the earth's eccentricity, and in the inclination of the axis I have discussed it in some detail elsewhere¹¹ Then the climates become more *zonal*, as they are today, with the Poles becoming colder (and possibly the Equator somewhat hotter) than in mid Tertiary times

Eocene monkeys, according to Matthew, occur in the Central United States and in France, which indicates that at that time there were tropical forests such as those in which the lemurs live today In Miocene times the forest belt has shrunk apparently, for the fossil



FIGURE 100—A generalized map showing the distribution and migration routes of the lemurs and apes in late Tertiary times (Based partly on Fig 7 in W D Matthew's *Climate and Evolution*) (From *Geographical Review* 1919)

anthropoids are found a little nearer the Equator, in Italy, around the Aegean Sea, and in Persia (see Fig 100)

When we reach Pliocene times the fossil anthropoids are still farther south, and are found in Northern India and China This may very well indicate the limit of the forested region of Pliocene times, though it is possible that it was not as hot and moist there as in the regions where the great apes are found today

However, we are justified in assuming that the region between the Indian Ocean and the Aral Sea (i.e., Persia and Turkestan) was forested country with a moist, warm climate We know that the great plateau of Tibet and the Himalaya Mountains were not fully developed till the end of the Pliocene, and probably Asia in the Pliocene as a whole was much more at sea level than it is now

¹¹ *Climatic Cycles and Evolution* op cit

The sea level temperature of Central Persia is about 75° now. If we imagine that the Pliocene temperature was 82° , we find that this agrees well with the temperature of the tropical forest belt. We may, therefore, assume that the apes and pithecanthropoids followed the thick forests as they gradually retreated to the Equator during the cooling of Miocene and Pliocene times. And indeed two monkeys of Miocene times *Dryopithecus* from the south of France and North India and the Indian *Sivapithecus* seem to be nearest to the ancestral line of man.

From the general trend of this argument the location of such missing links as *Pithecanthropus* in Java and *Eoanthropus* in Britain is seen to have little bearing on the question of the human cradle land. They are almost certainly examples of the last relics of a bygone type which have been pushed to the margin by later-evolved forms. Such primitive fossil types would be expected to occur on a circle around the actual cradle land (just as the primitive Negrito and Negro people are found on a curved zone around the original centre of evolution) but at a very long distance therefrom.

E Genetic Relation of the Races

The accompanying diagram (Fig. 101) sums up the biological aspects of the foregoing discussion. The fundamental teaching of racial ecology is that there are *twain races* in each group, i.e. what we might call a Pacific and an Atlantic twin. For instance among the Negritos we find the Aeta and the Congo pygmies—and so all the way up the scale. Hence the ecology demonstrates the likelihood of a common cradle land for each pair of twins. We have corroborated this common cradle land from race history for the Alpine and Mediterranean groups. It is logical to assume it therefore for earlier groups. Secondly the breadth index of the head changes progressively as shown by the numbers in Fig. 101. Thirdly the latest developed race is the late Alpine type which extends from Switzerland to Korea. Lastly the most logical conclusion as to the affinities of the Negrito is indicated in the tree: it is to assume two precursors of modern man living in middle Palaeolithic times. This was about 50,000 B.C. in France but was probably several hundred thousand years earlier in Central Asia. These two were Neanderthal man and the Proto Negrito (Grimaldi?) type. From the former developed the four later races.

If the reader is at all impressed by the value of the "Zones and Strata" (or "Age and Area") concept as applied to the mammals by Matthew, he will, I hope, be inclined to accept this presentation for the human races as reasonably correct. Matthew shows that the ecology of the tapir, the rhinoceros and the horse, when considered together with their palaeontology, is sufficient to demonstrate the order of their evolution and migration. The present writer hopes that he made out in 1919 an equally good case for the evolution, migration, and relative status of the Alpine, Mediterranean, and Negro races.

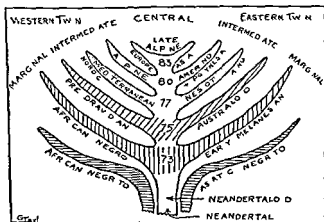


FIGURE 101 —The racial 'tree' showing the relations of the five races. The twin distribution is most striking, and indicates a common cradle-land for all the races. The Negroites evolved from a non Neanderthal type, the Negroes and the other races from a Neanderthaloid. (From *Ecology* July 1934)

F Appendix on the "Zones and Strata Concept"

The writer feels that the application of this concept in all problems of distribution is one of the chief advances in geographical technique in the last few decades. He therefore shows two more examples, one based on distributions of Culture, the other on the distributions of Plants.

In Fig. 102 (right) Wissler illustrates the evolution of technique in archery. The primitive release was used by the earliest bowmen, who almost certainly first exercised their art in Central Asia. Today this technique has spread to America and the East Indies. But in the cradle land it has given place to the *Mediterranean* release (using

three fingers), or to the still later *Mongolian* (using the curved thumb) The analogy with the later race-distributions is complete¹²

In Fig 102 (left) the gradual spread of the primitive *Ginkgo* tree as described by Seward is illustrated¹³ It has gradually been displaced from its original habitat by later genera better suited to the

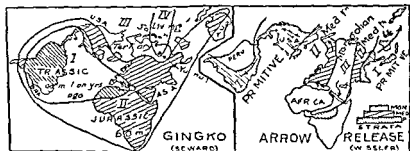


FIGURE 102—Two further illustrations of the application of the 'Zones and Strata' principle to migrations of culture (archery) and plants (*Ginkgo*)

later environments In far distant Triassic times it was found only around the mid Atlantic Ocean Today it only exists (as a native) in Yunnan, though originally it covered much of the world Note that this last relic of the ancestors of modern trees is found in a marginal position, far from its cradle land Some such history could in a few years be written about the Negritoes, who will soon vanish from the face of the earth

¹²*Relation of Man to Nature* (New York 1926)

¹³*Ginkgo biloba* (*Annals of Botany* London vol XIV, 1900) The *Oxford Dictionary* gives the spelling *Ginkgo*

PART III

THE PRESENT

WHITE SETTLERS IN A COLD CONTINENTAL ENVIRONMENT

B. WHITE SETTLERS IN A HOT ARID ENVIRONMENT

CHAPTER XXII

THE CANADIAN ENVIRONMENT THE MARITIMES

A Introduction

In Chapter II a good deal of information regarding the geology of Canada has been given, but only in a general sense. In the present chapter attention is drawn to the fundamental *physical* factors in Canadian geography.¹

If we examine the section below the mantle map given in Fig. 103 (which extends from Vancouver to Montreal), the threefold character of Canadian geology is well brought out. In the west is the complex series of Young Folds constituting the Rocky Mountains and parallel ranges. In the centre is a series of undisturbed deposits mostly sloping to the east, of which the Cretaceous formation shows the largest extent. In the east are large areas of the Shield, which in places is covered with younger strata. The reasons for this arrangement are given in the earlier paragraphs of Chapter II.

Now let us turn to the mantle map above the section (Fig. 103), where we see the above divisions in plan. There are clearly five main geological divisions in Canada. First, the *Precambrian Shield* surrounding Hudson Bay is dominant. Secondly, there are three undisturbed Palaeozoic formations laid down along the south-west shores of Hudson Bay. They may be termed the *Hudson Palaeozoics*. Then, thirdly, there is the rather complex patchwork of "mantles" which lie on the western flanks and the northern ends of the *Appalachian Folds*. Here the Cambrian Core is covered with an Ordovician mantle, and capped by Devonian. It forms the southern shore of the St. Lawrence. In the Maritimes the essential feature is an upper mantle of Carboniferous rock, which contains much valuable coal. In Southern Ontario is a sequence like the Hudson Palaeozoics, with the hard Silurian mantle forming a ridge (cuesta) which extends from Niagara Falls all round Lake Huron and Lake Michigan as far as Chicago.

The fourth division is the *Western Slopes*, comprising the area between the Shield and the Young Folds of the Rockies. This area

¹For further details see the author's advanced geography of CANADA (London 1947).

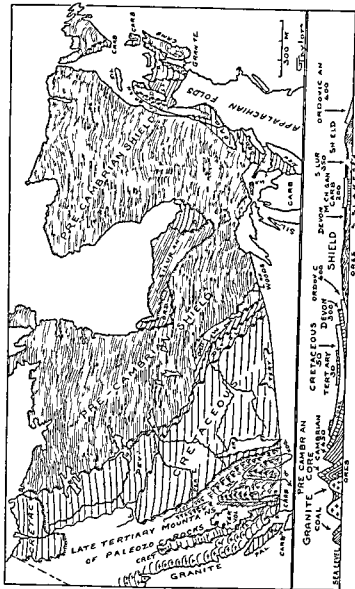


FIGURE 103—A mantle-map of Canada, in which the later geological formations are shown as "mantles" flung over the older formations. Below is given a simplified geological section near the southern border of Canada from Vancouver to Montreal. Figures mean millions of years ago. (From *Canadian Geographical Journal* March, 1936)

consists of two parts, of which the *northern* comprises the Mackenzie Basin (formed of the Devonian mantle) and a later Cretaceous mantle crossed by the Peace and Athabasca Rivers. The *southern* part is the Saskatchewan Basin, almost wholly in the Cretaceous mantle, though the edges (cuestas) of Palaeozoic rocks are exposed near Lake Winnipeg. The outstanding feature of this division is the way in which the cuestas of the younger rocks help to hold up the waters of the huge lakes lying on the Shield.

The fifth division, the *Young Folds*, is the most complex. The latest folding forces raised the Rockies in a series of ridges running north west to south east. It is supposed that the folding was due to the squeezing of weaker sediments between the resistant Shield and the very stable crust under the north Pacific Ocean. A broad and shallow downfold flanks the uplift on the east, and along this the Mackenzie River makes its way to the Arctic Ocean. The close set wrinkles of the Young Folds have determined the curious upper courses of the rivers in British Columbia, such as the Kootenay, Columbia, Fraser, Peace, and Liard. The topography is rugged, and hence very different from the relatively undisturbed rocks in most of Canada. Large areas are covered by Tertiary volcanic lavas which flowed out as a result of the crumpling of the crust. A great deal of erosion has removed the upper portions of the folds, so that the ancient rocks forming the 'cores' of the folds are exposed in many places. The coal has been compressed and improved in quality in the small fold basins in this fifth division. The glaciers of the last Ice Ages (within the last one million years) have carved out deep valleys and fiords in this area of Young Folds. Hence good harbours, but only very small areas of good agricultural land are characteristic of our last division.

Although the former coalfields have been disrupted, elevated, and often completely eroded in the western folded area, yet the deep valleys and the uplift of the once deep seated intrusive rocks have greatly improved the chances of finding metallic ores. This is indicated at the base of Fig. 103, where is given a simplified geological section near the southern border of Canada. In the east the valuable 'Coal Syncline' of Carboniferous rocks in Michigan is shown, bordered by the Frontenac portion of the Shield on the east. The Great Lakes (black in the section) lie in hollows, in part eroded in the softer Devonian and Ordovician mantles, while the hard Silurian cuesta separates them from each other.

In the foregoing maps only the solid rocks of the crust have been considered. Practically the whole of Canada has been covered by the ice sheets of the Great Ice Age and these have torn away a good deal of the mantle of soil which covered the rocks and unfortunately have dumped much of it in the gigantic moraines which cover the Northern United States. The Precambrian Shield has lost much of its agricultural value for this reason. However, in most parts of the Shield crossed by the writer and he has traversed about 1 700 miles of it a fair covering of rather poor soil all carrying trees is present throughout. The bare areas near Lake Muskoka and Lake Superior where most people see the Shield are not typical of it as a whole. Another feature which has greatly contributed to the resources of the Shield is directly due to the great ice sheet. It is illustrated in Fig 119. As the ice retreated across the main divide between the Hudson and the southern drainage basins the rivers on the north of the divide were dammed back by the ice front. In this way two colossal lakes were formed each comparable in size with the combined area of the present Great Lakes but these features Glacial Lakes Agassiz and Ojibway are discussed at considerable length in later sections.

B General Physiography

If we examine the contour map of Canada (as shown in Fig 104) we find that there are visible a number of fundamental features which are of considerable geographical interest. They are of course closely linked with the geological structure. Clearly the main grain of the country runs from north west to south-east not only in the Tertiary Folds of the west but also in the east where the Greenland Coast and Davis Straits exhibit this direction. In Canada in Tertiary time or later the Shield has been raised over 3 000 feet in Baffin Land and in the Torngat Mountains in Labrador. In both areas the ridges run in the dominant direction. The Shield slopes down to the east where it is drowned by the shallow waters of Hudson Bay. The largest area of lowland in Canada (below 250 feet) borders the western shore of this huge bay. An important low area of the type called a Gate elsewhere extends from James Bay to the lower Ottawa River. This we may call the *Te miska ming Gate* from the elongated lake which lies along its lowest part.

The Great Lakes as has been noted often are to some extent scooped out of slightly higher ground than lies north and south. As

we have seen, they are due to a combination of glacial erosion and crustal warping. But another important Gate lies between the Nipigon Uplands and the Western Prairies. This includes the Red River Basin, by which the ice drainage formerly reached the Mississippi Basin. The broad gap including Traverse Lake may perhaps be called the *Red River Gate*

In the south centre the land rises fairly regularly from Lake Winnipeg to the Rockies. There are, however, some interesting cross valleys, such as those of the Qu'Appelle River and the North



FIGURE 104—The main contours of Canada, showing the N.W.-S.E. "grain" of the Dominion. Note the three chief gates out of the northern lowlands *via* Temiskaming, Red River, and Finlay Forks (F). (Heights in feet.)

Saskatchewan, which may represent drainage channels which developed along the front of the retreating ice-lobes. But to the north of the Prairies the Mackenzie River and the three Great Lakes of the north occupy another broad area of lowland with the usual dominant axis. Indeed, perhaps we may claim the whole belt of Great Lakes, from Erie to Great Bear, as another example of this dominant "grain."

The Dease and Parsnip Rivers (the western tributaries of the Liard and Peace Rivers) rise to the west of the highest mountain ranges. They seem to be, in part, relics of an antecedent system of rivers, which originated before the "Laramide Revolution" producing the

Rockies It seems clear that the most important gap in the Canadian Rockies is at Finlay Forks (*F* in Fig 104), where the Peace River is joined by the Parsnip River at about 2,000 feet above sea level. This natural depression, the *Finlay Gate*, leads south by the "Rocky Mountain Trench" (p 350) to Prince George on the Canadian Northern Railway, near the big bend of the Fraser River.

From Prince George to Prince Rupert there is a broad sag in the interior plateau of British Columbia, giving us large areas below 3,000 feet. This is indicated by the ruled area in Fig 104, and it extends from Finlay Forks to Prince Rupert as well as south along the Fraser River. The marked "grain" in British Columbia is discussed later. Possibly we may refer all these folds and broad warps to the pressure exerted by the Pacific Shield (Fig 3) against the weaker rocks of the east, in which *sharp folds* are produced, or against the resistant Canadian Greenland Shield, in which case *shallow* but perceptible warps seem to have been developed.

C *Climatic Controls in Canada*

Man inhabits the earth by favour of satisfactory geological and climatic controls. The former determine the topography, the mining resources, and, to a large extent, the soil resources. It is true that man can modify climatic controls and exist in defiance of unattractive climates with such devices as "Central Heating," or the even more important "Central Cooling." But such devices cannot be used all the year round by large populations, so that the statement that "climate controls settlement" will always hold good.

In Fig 105 some of the characteristic features of the Canadian climate are illustrated. One of the primary distinctions in climate is between those climates with a small range of temperature in the year (*Marine Climates*) and those with a large range (*Continental Climates*). It is found that most of this range of temperature in the cool temperate zone is due to the extreme cold of *winter*, for in summer the conditions vary much less over wide areas. For instance, Madrid and Naples lie in about the same latitude as Toronto and Chicago, but everyone knows that the climates are not at all alike. Which is the *normal* climate for latitude 42°? We can examine this problem by considering the January "Isanomalous" chart.

When we average the January temperatures of places along this latitude, we obtain a figure of 37° F. Since Chicago has a January

average of 23° F., it is obviously 14° colder than the normal for its latitude. Similarly Toronto is 11° colder. But Madrid and Naples are respectively 10° and 6° warmer than the averages for their latitude. These figures - 14, - 11, + 10, and + 6 are "Anomalies," and lines can be drawn through equal anomalies (Isanomalous lines) as is done in Fig 105. We find that Toronto and Chicago lie close to the centre of negative (cold) anomaly, while Naples and Madrid are near to the positive (warm) anomaly. Hence neither group has a normal climate. This is only to be found between the two centres along the line of "No Anomaly" (Fig. 105), which runs just off the east coast of North

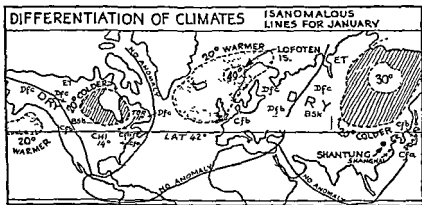


FIGURE 105 — A chart showing foreign climates akin to those of Canada. The ruled areas have midwinters much colder than the averages for their latitudes. The dotted areas have midwinters much warmer. Chicago and Toronto have homoclimes in North China. Koeppen's formulae for Canadian climates are also added

America. The new port of Churchill has a peculiarly cold climate, while the Lofoten Isles off Norway have what we may call the most "unexpected" climate in the world. It is 40° warmer in midwinter than one might reasonably suppose.

It is clear, then, that latitude alone is no very good clue to the climates resembling those of Southern Canada. We find in Eastern Asia another area of negative anomaly, which is always a characteristic of Continental climates; just as a positive anomaly is often a feature of Marine climates. Clearly the regions of similar climates (*Homoclimes*) of the Great Lakes are to be found to the south and south-east of this large area of negative anomaly in Asia. Accordingly we can say that Shantung, Shanghai, and the vicinity in China agree

pretty well with Toronto and Chicago as regards their most characteristic month (January)

Luckily, however the economic resources of a country do not depend so much on the winter climates as on the summer climates which vary much less drastically over very wide areas. For instance, the summer or growing seasons of Naples and Toronto are not very different. The eminent German climatologist Koeppen has produced a classification of climates which lays stress on the rainfalls as well as the temperatures, and has devised formulae for the different classes. A few of these formulae which occur in Canada are shown in Fig. 105. Thus in the extreme north of Canada and Siberia the tundras are both labelled *ET*. Most of the forest lands of the centre and north have the formula *Dfc*. Here *D* means snow forest, *f* means fairly uniform rain, and *c* means cold (less than 4 months over 50° F). Homoclimes are found from Leningrad to Vladivostok.

The region of the Great Lakes and Southern Manitoba is *Dfb*, where *b* means 'more than four months over 50° F'. Its homoclimes are Poland and Central Russia. The Lake Erie and Vancouver regions are *Cfb* and are the homoclimes of Central Japan and North France respectively. Southern Saskatchewan is *BSk* (cold, dry steppe) and these prairies are the homoclimes of the Siberian region north of Aral and Balkash.

It is clear therefore that Canadians have a very special interest in Poland and the Soviet Union, since the climates and so many of the resources must be the same. In fact only a small area of Canada near Vancouver has the Marine climate associated with the homeland in Western Europe. Hence we must realize that the Canadian environment is quite different from that specially studied in English texts, and needs local investigation in which we can, perhaps learn much by interchange with Russian researchers.

Let us turn now to the local controls by the Canadian climate they are peculiarly interesting to an Australian geographer like the writer. In Australia the temperature conditions are in general satisfactory throughout the continent but about three quarters of the area suffers from a shortage of rain. In Canada the precipitation is in general satisfactory but about three quarters of the country suffers from low temperature conditions. Planning for satisfactory future settlement in both countries largely consists in the production of accurate maps and their interpretation and translation into enlightened action.

In all questions of comparative climatology, the writer finds very helpful the graphs which he devised in 1916² These are called hythergraphs (from *hyetos*, "rain" and *therme*, "heat"), and these (with their wet bulb analogues, the climographs) have been widely used by climatologists Typical hythergraphs for Australia and Canada are given in Fig 106

Each hythergraph is a twelve sided polygon, where the twelve corners are plotted from the twelve monthly rainfall and temperature averages at the place Thus Toronto in January has a temperature of 23° F and a rainfall of 2.7 inches This gives the position of the point JAN at the bottom of the hythergraph for Toronto The upper point of the graph shows 68° F and 2.8 inches, and these are the data for July The data for the other months complete the graph

Comparisons of all places (as regards these chief components of climate, i e, rain and temperature) are made easy by these graphs If we examine the graph for Sydney (Australia), it is an oval figure for the most part in a rather different part of the chart But clearly the climate from August to December in Sydney is very like that from May to July in Toronto

In general, places approaching the four corners of the chart have either "keen," "raw," "muggy," or "scorching" climates *Continental* climates, like Edmonton or Toronto, have large extremes of temperature, which appear in the elongated vertical character of the hythergraphs *Equatorial* climates are extended horizontally, like the upper part of the Broome graph *Monsoon* climates (with a dry winter) are crescents like Broome *Mediterranean* climates, with their dry summers, have a diagonal position like Perth (W A) *Desert* climates are close to the left edge (low rainfall) like Alice Springs

The most comfortable conditions for white settlement are included in the square frame or thereabouts This indicates summer months not exceeding 67° F, and winter months not below 45° F The rainfall should vary between 1 and 6 inches per month Hobart (Tasmania) lies wholly in this square So also do the eight warmer months of London, England In general, both hotter and colder conditions are less uncomfortable if the air is moderately dry A fairly complete discussion of such problems (illustrated by 70 graphs) will be found in the writer's memoir, "Control of Settlement by Temperature and Humidity"³

²*Australian Meteorology* (Oxford, 1920)

³*Meteorological Bulletin* 14 Melbourne, 1916

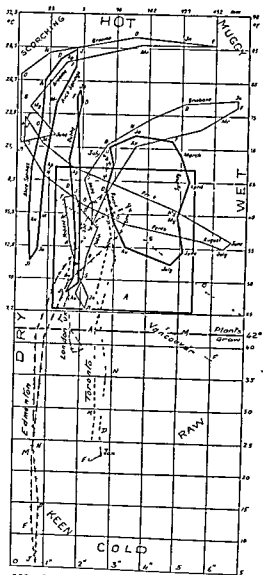


FIGURE 106—Hythergraphs of typical places in Australia and Canada At 42° F plants begin to grow The square frame encloses the "most comfortable" climates for white folk

D Temperature Control

Turning now to considerations of temperature, the most important control of settlement in Canada, one of the first features to be stressed is the Duration of Daylight. Since most food crops of vital importance grow within the three or four months of *summer*, the duration and intensity of winter are of much less importance in determining settlement. Wheat-crops have been grown at Khibiny, the Russian Experimental Station far north of the Arctic Circle, in 67° 44' north, for eleven years. In most of these years "Early Northern" wheat has yielded good grain, either in the "waxy," or in the complete, stage of ripeness. This is only possible owing to the long summer days in high latitudes.⁴

Koepppe in his valuable book on the Canadian climate⁵ gives the following figures for the amount of solar heat received at various latitudes on June 21. (Allowance is made for the mean cloudiness)

Latitude	45	50	55	60	65	70	75	80	85
Solar heat	508	518	469	468	489	462	410	451	327

It is clear that there is practically no difference in the heat received on the ground from latitude 55° to latitude 80°. As we travel north, the sun's rays become more oblique and less hot, but the days become longer, so that the total heat received (around midsummer) remains much the same.

We may now turn to the isotherms of the warmest month, which are shown on Fig 107. These isotherms do not run west east as is normal, but their direction is north west to south east, mainly due to the presence of the great ice cap of Greenland, the cold waters of Davis Strait and Hudson Bay (the warming) of the westerly winds on crossing the Bering form a "hot loop" in the Mackenzie Basin. In the Boothia Peninsula, between the slightly warmer and the Beaufort Sea. This is indicated by as a broken line in Fig 107.

⁴*Geographical Review* July, 1937

⁵Bloomington, Illinois 1931

The advance of agriculture on the cold frontier of settlement will take place in the belt between isotherm 61° F and isotherm 57° F. This belt is emphasized by dots in Fig 107. Although the data are for July they give a fair idea of the region which is fairly warm in the three summer months.

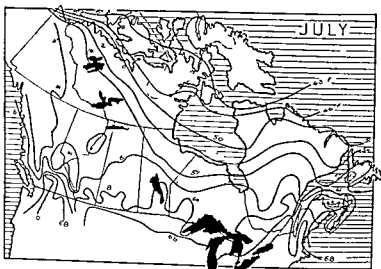


FIGURE 107 — Isotherms for July in Canada. It is primarily the summer temperature which determines the limits of crops. Cent grade figures appear at left. Simpson (62° N) is warmer than Saint John (45° N).

E Rainfall Control

As regards rainfall the data are rather incomplete especially in the Mackenzie Valley. A record of some forty years is necessary to give us reliable average figures and this is lacking. However Fig 108 shows the main features of the rainfall. The isohyets are clearly concentric about Boothia which has the lowest rainfall on the mainland. The heaviest rainfall is on the west coast of Vancouver Island which receives 200 inches a year. In the east only a portion of the Maritimes (and the district near Quebec City) receive over 40 inches.

It is clear therefore that the Arctic regions and the interior of Canada are disadvantageously situated for heavy rainfall. On the other hand the warm coastlands are the best situated since permanent warm onshore winds always bring about heavy rains. The

moist air from the sea is chilled as it surmounts the land, and therefore much of the water-content of the wind falls as rain.

Of recent years, however, the importance of cyclones in producing rainfall has been stressed. These are eddies in the air which develop where two large masses of air come in contact. The method of rain-



FIGURE 108—Mean annual rainfall (Brooks and Connor); with the 15-inch isohyet and seasons added

production due to the movements of these "air masses" is described in the following analysis from a recent paper on the subject.⁶

During the last few years since intensive meteorological observations of the upper air have been made, a large amount of information regarding the characteristics of the atmosphere has been obtained. It has been possible to determine the temperature, pressure, moisture-content, and velocity and direction of movement of the air at various levels aloft. From these observations it has been fully demonstrated that great masses of air develop uniform properties in various so-called "source regions," and from time to time burst forth from these source regions and migrate along different routes across the continent.

⁶C. W. Thornthwaite, "Climatic Studies" (Conference on Canadian American Affairs, Kingston, 1937, mimeo)

The vast Arctic tundra is the source for the *Polar Continental* air masses which are consistently cold and dry, and therefore heavy. The north Pacific Ocean is the source region for *Polar Pacific* air masses which are characteristically cold and moist. The Gulf of Mexico and the Caribbean Sea is the source region for *Tropical Gulf* air which invariably is hot, very moist and light. The area between Bermuda and the Bahamas is the source region for *Tropical Atlantic* air masses which like the *Tropical Gulf* air, are warm moist and light.

Most of the rainfall of Eastern North America is due to the interaction of the polar and tropical air masses. When the *Polar Continental* air pushes out from its source region and flows southward across the Canadian Prairie Provinces and into the plains and prairie states and thence south and south eastward to the Gulf and the Atlantic it collides somewhere along its route with the lighter and moister tropical air from the Gulf or the Atlantic. The latter air, being lighter is forced to ascend and become cool, and being more moist is forced to yield up precipitation. The storm which produced floods on the Potomac and the James in Virginia and the Thames in Ontario in March 1937 was due to such an interaction of air masses.

The seasonal variation of the rainfall is mainly due to the swing of the rain belts with the sun which has been described in earlier chapters (p 114). Thus in winter, onshore winds are more prevalent around Vancouver Island. In the same season cyclones (with their ascending chilled air) are abundant over the Maritimes.

In the interior the summer heating leads to the production of columns of rising air by the process of convection. These in turn produce thunderstorms which account for a good deal of rain in Alberta. Mention must also be made of the warm *Chinook* winds in Alberta. They descend on the lee side of the Rockies are compressed and therefore heated and so lick up the snow during the spring months. Near Hudson Bay the late melting of snow and ice retards the convection effects mentioned above until the *autumn*. In the latter season the maximum rain falls in this area. Between the winter and the summer rain regions as at Toronto and Calgary the rain falls fairly *uniformly* throughout the year.

F Structure and Settlement in the Maritime Provinces

The intimate relationship between structure geography and history is nowhere better illustrated than in the earliest industry

in Canada. Cabot discovered Canada in 1497, and it was almost immediately visited by many fishing boats, notably from Brittany and the Basque districts near the Pyrenees. Cartier found traces of fishing stations around Cape Breton as early as 1534. One of the earliest permanent settlements was at Tadoussac on the Saguenay in 1599, and fishermen soon began to spend the long winter in Canadian stations. Until the ten thousand Loyalists arrived in the Maritimes (after the War of Independence) *inshore* fishing for cod was the chief industry. Lunenburg (Nova Scotia) is now the centre of deep-sea industry.⁷

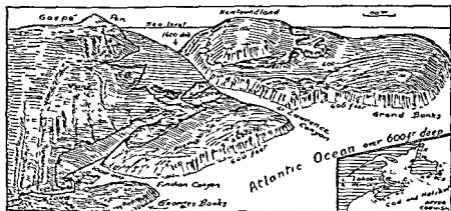


FIGURE 109—A block-diagram (somewhat generalized) of the fishing grounds of the Maritimes, as they would appear if the Atlantic Ocean sank 600 feet. Note the Cretaceous cuesta near New York.

The four great fishing nations of the world are the Japanese, and the British and their descendants in the United States and Canada. The fishing grounds off Nova Scotia and Newfoundland cover an area of about 200,000 square miles. Nowadays in addition to the cod and halibut caught in the deeper waters, the inshore fishing for lobster and herring is of equal importance. The value of the fishing industry in Canada is about fifty million dollars a year, of which about half is won in Eastern Canada and half in British Columbia. The order of importance is salmon, largely from British Columbia, lobster, cod, herring, and halibut. In the east, Nova Scotia and New Brunswick are the chief producers.

If we imagine that the level of the Atlantic Ocean were to drop 600 feet, the coastal landscape would look something like Fig. 109.

⁷See R. F. Grant, *The Canadian Atlantic Fishery* (Toronto, 1934).

The fishing banks are obviously drowned portions of the continent and the rapid slope from 300 to 600 feet marks the old shore line. The proof of this subsidence is furnished by the *submarine canyons* of which two are indicated in Fig 109. Only river erosion could produce the long deep troughs of the St. Lawrence and Fundian Canyons. The former is 1 600 feet deep off Gaspé Peninsula though the sea on each side of the canyon is quite shallow.

It is the presence of these shallow waters, which carry an abundant supply of fish which directly led to the settlement of Canada in the early seventeenth century. Only in one place remote from land is there a portion of the Banks which rises above sea level. This is Sable Island, a long sandy crescent which crowns a submarine rise. We know little of the geology of these banks but it has been suggested that they represent extensions of the Mesozoic rocks (Trias Cretaceous etc.) which form the coasts near New York City. These rocks help to build Long Island and Cape Cod and may extend to the north east to buttress Georges Banks and the Grand Banks. Possibly huge deposits of ground moraine left by the ice may form part of the banks. Such moraines build up much of Long Island but they have not filled the submarine canyons to the north east as might have been expected. The epoch when this subsidence occurred is not yet known.

The three Maritime Provinces are sketched in Fig 110 which is a mantle map showing the structure of this part of Canada. Its past geological history has been rather complicated in its earlier phases. In Ordovician and Devonian times (see Fig 5) it was crumpled during the widespread earth folding. Great masses of granite rose up from below in Devonian times (6) forming the rounded ridges on each side of the Bay of Fundy. Since that time a mantle of Carboniferous rocks (7) was laid down in the central portion covered in turn by Permian deposits (8) and Triassic deposits (9). Sheets of basic lava form the latest rocks and build up the North Mountain along the famous Cornwallis Valley in Nova Scotia.

Generalizing somewhat we are therefore dealing with a syncline (basin) which has been crumpled in its earlier phases. But the older rocks (2 and 3) occur at the margins in Gaspé and on the Halifax coast while younger and younger rocks overlie these as we approach the centre of the basin which lies near Minas Bay. The population pattern (inset in Fig 110) shows some agreement with the structure. The empty areas are the ancient marginal mantles like the Devonian granites of Nova Scotia and the upland Devonian and Silurian

more of New Brunswick. There is, however, a good deal of coal mining in the Precambrian rock behind Halifax. The Carboniferous rocks contain good coal in several districts, especially at Sydney, and near Fernald and Moncton. A good deal of iron from the immense deposits of Bell Island (nearby in Newfoundland) is smelted in Sydney.



FIGURE 110—A mantle map of the Maritime Provinces showing the various geological formations numbered 1 (of left) to 10. Below is an approximate geological section. Inset above is a population map.

Forests still clothe the rougher higher portions of the Maritimes. In general the soil is poor since it is derived largely from ancient rocks. But some of the Silurian limestones near the St. John River weather to form good soils. Furthermore, in a uniform rainfall region the soils tend to be gradually leached of their plant food and so become sterile *podsoils*. This is unfortunately true of much of the country. However, some of the main river valleys such as the St.

John and some of the younger mantles such as the Permian of Prince Edward Island and the Trias of the Cornwallis Valley, have given rise to fertile soils leading to prosperous farms in these areas. The denser population scattered along the coast is due to a large extent to the prevalence of fishing the importance of which has already been emphasized.

G *Traverse across the Maritimes**

A brief account of a traverse made by the writer from Halifax to Edmundston will give an idea of the environment. The steep rocky coast near Halifax is dotted with large mounds of glacial debris known as drumlins. Inland the ancient rocks are covered with red spruce and balsam fir and contain many small lakes. As one reaches the Minas Basin gypsum quarries are visible near Windsor. The mud flats at the head of the Bay of Fundy were dyked by the early French settlers. This is Evangeline's Country and is still noted for heavy crops of sea flat hay. The natural forest contains more birch maple and beech than elsewhere while such southern types as basswood and butternut occur near Saint John. Spruce is however very common throughout. As in many marginal settlements primitive methods survive even if the land has been occupied for three centuries. The photograph of ploughing with oxen taken not far from the old Fort (1606) at Annapolis illustrates this point (Plate III Fig 1).

Some of the best apple orchards in America are to be found in the long narrow Cornwallis Valley. Near Truro is hilly farming country and thence we climb over the Cobequid Hills to Amherst. Here are more dyked flats with large hay crops such as marked the Minas Basin. Near Moncton is a centre of the fox farm industry which is however more important in Prince Edward Island. The east coast of New Brunswick is strongly French and this is marked by the prominence of the large churches often with shining metal steeples. This region contains many swamps so that cedar and larch as well as the usual black spruce and hemlock are abundant. (See Inset Fig 124.)

From Chatham to Fredericton by way of the Miramichi Valley

*In 1935 and 1936 the writer made two traverses of the Dominion between Halifax and Victoria examining in detail typical areas right across. Photographs taken on these journeys appear in order on Plates III IV and V. Brief descriptions of the features noted on these traverses will be found on each section.

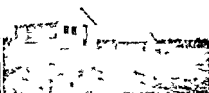
¹W. E. Halliday, Forest Classification for Canada. (*Forest Bulletin* 89 Ottawa 1937). The writer has found this most useful.

PLATE III

TRAVERSE OF EASTERN CANADA



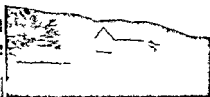
1—Oxen ploughing 6 miles west of Annapolis Nova Scotia



2—Building log cabin 1 mile south of Grand Falls New Brunswick



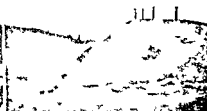
3—Oshpigon canal at Cardinal St Lawrence River near Prescott



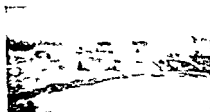
4—Cap of Great Shield Eardley 18 miles north east of Ottawa



5—Old blockhouse and lock (Rideau Canal) Merrickville



5—T1 on road 9 miles west of Perth Ontario



Perched 1000 ft farms on Shield N. of Lake Muskoka



8—Farm on Shield 1000 ft Lake Muskoka

there are only scattered farming villages amid wide stretches of black and red spruce and birch. Pioneer log-cabins are still being erected in new clearings in parts of this long-established province (Plate III, Fig. 2). The broad valley of the St. John from Fredericton to Edmundston is one of the most prosperous farming regions in the Maritimes. A good deal of lumber is cut in the vicinity, but most of the white and red pine has been marketed. Oats, potatoes, hay, vegetables, and dairying occupy most of the farmers. In the larger farms the buildings cluster in a long continuous row, very different from the scattered pattern of the farms in the prairie country.

CHAPTER XXIII

STRUCTURE AND SETTLEMENT IN QUEBEC AND ONTARIO

A The St. Lawrence Valley

The next province to be considered in this survey is Quebec. It has a huge extent covering 594 534 square miles but unfortunately most of this consists of sterile Shield and 62 per cent has a climate which seems to prohibit profitable agriculture. Hence we can confine our attention principally to the area in Quebec where a noteworthy population dwells. This is shown in the inset in Fig. 111. Clearly it is confined to the St. Lawrence Valley with extensions into the Saguenay (St. John) and Ottawa areas.

Cartier visited Stadacona (Quebec) in 1535 but it was not permanently settled till the time of Champlain in 1608. Its importance on the great water way of the St. Lawrence just where the estuary contracts sufficiently to be bridged is manifest. Here also the Laurentian (Canadian) Shield begins to be covered with younger rocks which much improve the possibilities of settlement. Montreal 150 miles up the river was founded as a religious settlement in 1642 and in 1665 the arrival of the Carignan Salieres regiment enabled the French to break the power of the Iroquois. There were 3 215 French in Canada in 1665. Montreal is also the head of deep water navigation for to the west lie the formidable rapids of the St. Lawrence. Here also the route of the French traders passed up the Ottawa River to Lake Huron which was known long before Lake Erie.

The structure of this part of Canada is given in Fig. 111. To the north lies the Laurentian Shield which rises to more than 2 000 feet some sixty miles north of Quebec. The north coast east of Quebec is all Shield and so has tended to remain a primitive farming community not very different from its condition a century or so ago. To the west of Quebec the Shield is bordered by a fringe of sedimentary rocks lower than the Shield and probably separated from the latter by a major geological fault plane. This is suggested in the geological section inset at the foot of Fig. 110. In fact much of the lowland region from Quebec to Ottawa is probably a *Graben* i.e. a block of the crust which has sunk relatively to the areas on each side.

The southern side of this depressed area is not so simply defined. At its west end is the dome of the Adirondacks. This is a southern promontory of the Laurentian Shield which has been thrust up above the surrounding younger mantles. The floor of the St. Lawrence between Kingston and Prescott consists partly of the very ancient and resistant rocks of the Shield. To this fact is due the presence of the Thousand Islands and of the rapids which obstruct navigation (Fig. 112).



FIGURE 111—Structure of the St. Lawrence Basin between Gaspé and Ottawa. The former drowned area known as the Champlain Sea is dotted. The volcanic plugs of the Monteregian Hills are labelled VOL. Prescott and Sherbrooke are indicated. The Laurentian is the same as the Canadian Shield.

Between Sherbrooke and Edmundston lie fold after fold of the Appalachian Mountains. These ranges consist of more or less parallel ridges and valleys built up of Precambrian rocks (1) or later Ordovician (3) or Silurian rocks (4). As has been stated earlier, they were finally crumpled in Permian times. But north of Sherbrooke for some sixty miles is a set of far more ancient folds (due to the Taconic period of crustal stress Fig. 5) which were thrust forward as far north as Logan's Line. These had been worn down in early geologic periods and were crowned with numerous volcanoes in late Devonian times now known as the Monteregian Hills. The hill called Mount Royal behind Montreal, which is built of syenite is one of these old volcanic relics. The lowest part of this folded area between the Adirondack Dome and the Permian folds of the Appalachians is occupied by

Lake Champlain This lake forms part of the important "corridor" between Montreal and New York

The structural feature which agrees most closely with the distribution of population is the "Champlain Sea," and this is shown dotted in Fig 111 For a time great ice lobes, whose weight certainly depressed the crust held up a greater Lake Ontario to a level of 200 feet higher than at present This stage is called "Lake Iroquois" and is discussed later After this enormous mass of ice vanished, the oceanic waters covered the depressed estuary, constituting the Champlain Sea Very slowly after the ice load had vanished, the crust rose into equilibrium, producing the hard bar of the Thousand Islands at Gananoque, and giving Lake Ontario its present boundaries In this lower area, once covered by the Champlain Sea, were deposited late sediments These mingled with the limy soils from the Ordovician rocks below, and gave much better soils than on the Shield to the north, or the Appalachian folds to the east

With such a diversified history throughout the geological record, it is natural that there shall be abrupt changes in the valley slopes These produce rapids, which are being utilized in many districts for the production of hydro-electric power One of the biggest plants in Canada is at Shawinigan Falls, near where the St Maurice River leaves the hard Shield for the softer lower rocks of Ordovician age Indeed, there is an almost continuous series of pulp-mills, dependent on the streams for floating the logs as well as for power, along the Saguenay and the smaller northern tributaries of the St Lawrence and Ottawa Rivers (Fig 115)

From Lake Ontario to Montreal, a distance of about 100 miles, the river drops 220 feet There are four main series of rapids each of which has been circumvented by a marginal canal to enable large boats drawing 14 feet, to reach the Great Lakes These canals are adjacent to the Lachine Rapids (near Montreal), Cedar Rapids, the Long Sault (near Cornwall), and again near Prescott¹

We may continue our traverse across the Dominion from Edmundston west to Ottawa (Fig 111) The country is at first quite hilly, with small scattered farms almost entirely in French hands as witness such quaint names as St Louis du Ha Ha In the lower areas cedar

¹A photograph of the canal with an oil freighter moving west upon it near Prescott is given in Plate III Photo 3 In the background is the St Lawrence River

is the chief tree with black spruce and larch, but on the hills balsam, fir, and birch are dominant. Elongated lakes, e.g., Temiscouata, in part carved by the ice, occupy many of the valleys.

Along the St. Lawrence from Rivière du Loup to Lévis, the belt of farm lands is very narrow. Long, narrow fields, usually with a heap of glacial boulders in the centre, have been carved out of the soils between the huge granite hummocks. External ovens and quaint verandah faced houses show that the country is almost exclusively French. West of Quebec the farm lands broaden out to form the "Eastern Townships." According to Halliday² the original forest was sugar maple, hemlock, white pine, and birch. But aspen and cottonwood, allied to poplar, are very common in the valleys. To the west beech, butternut, and elm become more abundant.

The farms are mostly small near Lévis and dairying is an important feature, but they become larger to the west. This region was not settled till after 1791, when considerable numbers arrived from New England and from Britain.³ The French migrants came later from the nearby coasts, and intermarried with the descendants of the Scottish soldiers. The next generation adopted French culture in large part, and have now occupied almost all Quebec Province south of the St. Lawrence. In 1837 in this district over 90 per cent were English, but in 1931 no less than 82 per cent were French. The Englishman will sell his farm and go west if he sees a prospect of profit. But the Frenchman will not sell, for he hopes to see his son and his son's son settle around him in the future.

Near Thetford are the largest asbestos mines in the world. They appear as huge open pits flanked by great piles of debris. The fibrous mineral has been developed in the ancient folded rocks of this part of the Appalachians. In the early days potash obtained by burning the timber was the chief 'cash crop'. Later timber cutting and normal farming replaced this wasteful practice. Dairying is the chief industry, involving the growth of large quantities of hay, oats, roots, etc. Buckwheat, tobacco and maple sugar are less familiar products.

²W. E. D. Halliday 'A Forest Classification for Canada' (*Forest Service Bulletin* 89 Ottawa 1937)

³J. A. Dresser, *The Eastern Townships of Quebec* (*Trans. Royal Society of Canada* sect. 2 ser. 3 vol. XXIX 1935). For the new iron mines see p. 212.

*B Structure of Southern Ontario**

It is impossible to obtain a clear idea of the geological setting of Southern Ontario without considering the build of the southern Great Lakes. In the north is the oldest formation, the undulating surface of the Laurentian Shield. It seems to have been for the most part a continental area of dry land since Cambrian times, some 450 million years ago (see Fig 112). All the rest of the region shown in Fig 112 has often been invaded by seas or lakes, giving rise to the marine or



FIGURE 112—A mantle-map of the Lower Great Lakes showing two basins (around Mount Pleasant and Pittsburg) separated by the Cincinnati up-fold (anticline). Notice the striking Niagara Cuesta (or scarp) extending from the Mohawk Gate north of Huron to Chicago. (From *Canadian Journal of Economics and Political Science* Nov., 1936)

other deposits indicated by the various mantles. These are numbered in order from 2 (the oldest) to 6, which is the youngest of importance in or near the Toronto region.

The key point in the build of the Great Lakes area is, perhaps, Fort Wayne in Indiana. It is situated on a *saddle* of rather resistant Silurian rocks (mantle 3 in Fig 112). To the north is the Michigan

*Based on a lengthy article on Topographic Control in the Toronto Region (*Canadian Journal of Economics and Political Science* Toronto Nov. 1936)

Basin covered by younger mantles (4, 5, and 6). To the south west and south-east are two other basins with the same structure. One centres about the Wabash River, the other about Pittsburg and the Upper Ohio River. The outstanding economic feature of this build is that the invaluable coal deposits occur in mantle 6 (the Pennsylvanian) and are preserved only in the centres of the three basins. Hence the prevalence of coal mines in Central Michigan, Southern Illinois, and around Pittsburg. Reference to the mantle map will show that from the Fort Wayne saddle one ridge fold (*anticline*) extends from Fort Wayne to Chicago, another to Cincinnati, and another to Sandusky.

The second main feature in the build of the Great Lakes is the *Niagara Cuesta*. This is the scarp of a mantle of hard Silurian limestones (3) which underlies the younger rocks but outcrops as a marked topographic feature all round Lakes Michigan, Huron, and Erie. It determines the peninsula at Green Bay, the peninsula near Sault Ste Marie, the Island of Manitoulin, the Bruce Peninsula, and finally the great scarp near Orangeville, Hamilton, and Niagara. The Falls themselves are, of course, due to the same feature. Far to the east it bounds on the south the Mohawk Gate, which in turn largely accounts for the dominance of New York as an *entrepôt* for America. Less directly Toronto has benefited from the Mohawk Gate.

The resistant Silurian mantle (3) lies above the weaker Ordovician mantle (2), and underlies the weak mantle of Devonian (4). This structure is in large part responsible for the presence of the Great Lakes themselves. No doubt warping of the crust and damming by glacial debris in part also helped to pond these unparalleled expanses of fresh water, but they certainly occupy broad valleys eroded by pre-glacial rivers in the *softer* rocks of the Devonian (4) and Ordovician (2) mantles (Fig. 7).

If we imagine the mantles in Fig. 112 to represent a series of hard and soft saucers (with Mount Pleasant, Michigan, above the hard Mississippian mantle (5) at the *centre* of the uppermost saucer), then a certain east-west symmetry in the arrangement of the lakes is obvious. This is emphasized in the table on the next page.

In the south-east of our mantle map the picture is complicated by the close set Appalachian folds, with their axes running north-east to south-west. These are so far from Ontario that we need not discuss them. However, it is important to notice that the Shield comes to the surface as the Frontenac axis (or up fold) near Kingston, and further south is buckled up into a sort of dome forming the Adirondack

GEOLOGY	<i>Soft Ordov</i>	<i>Hard Silur</i>	<i>Soft Devon</i>	<i>Hard Mississ</i>	<i>Soft Devon</i>	<i>Hard Silurian</i>	<i>Soft Ordovician</i>
MANTLE	2	3	4	5	4	3	2
RESULT	Green Bay	North west Michigan	Lake Michigan	Michi- gan State	Lakes Huron and Erie	Manitou- lin and Niagara Cuesta	Georgian Bay Lakes Simcoe and Ontario

Mountains Between this hard dome and the hard Silurian mantle (3) the soft rocks of the Ordovician (2) have been eroded to form the Mohawk Gate

In concluding this section it may be noted that the floors of three of the Great Lakes are far below sea level This indicates that they do not wholly occupy valleys due to by gone river erosion since rivers cannot erode below the sea (which is their base level) Lake Erie is relatively very shallow not much of the lake being more than 80 feet deep while the other three are in places more than 500 feet deep

The next map (Fig 113) shows the region between Lake St Clair and the Trent River Nearly the whole of this area is deeply covered in the glacial debris (Till) of the last Ice Age but this is unable to obscure the Niagara Cuesta, which forms a scarp from Georgian Bay across Niagara Falls and well into the United States However it is the characteristic features of the mantle of Till which are emphasized in Fig 113⁶

The outstanding features represented which are based on the work of F B Taylor⁶ are the *horse shoe moraines* which extend from Lake St Clair to Georgian Bay and thence south east to Long Point on Lake Erie Their origin is explained in the inset in Fig 113 Here we see two lobes of the retreating ice cap covering Huron and Ontario respectively A large crescentic glacial lake covered most of Erie the Thames Basin and some parts of Lake Huron This has been named *Glacial Lake Warren* Between this glacial lake and the ice lobes was an extent of bare land named by Taylor Ontario Island It agrees

⁶A photograph taken near Perth is given in Plate III Photo 6 It shows typical Till with large granite errata 2 feet across lying haphazard in finer gravels and silts

⁶The Moraine System of Southwest Ontario (*Transactions of the Royal Canadian Institute* Nov 1913) See also later papers by Chapman and Putnam in the *Transactions of the Royal Society of Canada* sect 4 1943

almost exactly with the "Region above 1,000 feet" shown in Fig. 113. Hence the horse-shoe moraines were laid down along the edges of the ice-lobes where they bordered "Ontario Island," which itself is relatively free from Till.

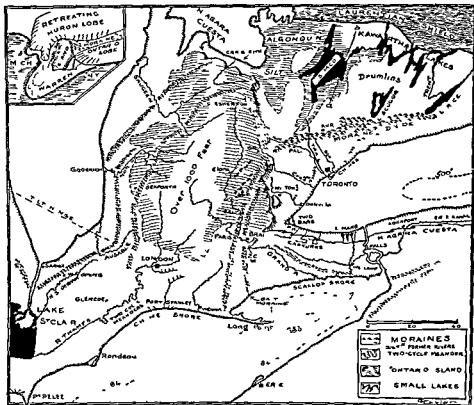


FIGURE 113—Physiography of Southern Ontario showing the large horse-shoe moraines about "Ontario Island," the Niagara Cuesta, and the effects of the tilt upward of the north. Inset is a diagram of Glacial Lake Warren, bounded on the north by "Ontario Island" and two ice-lobes (Partly based on F. B. Taylor)

The inner horse-shoe moraines, shown surrounding the higher country in Fig. 113, are a little earlier than the outer. Probably the Seaforth-Flesherton-Paris moraine is really a single structure, though it has been much eroded where modern rivers, such as the Maitland, cross it. So also the outer Wyoming-Goderich moraine may have been laid down at the same time as the Galt moraine near Long Point.

When the vast ice lobes shown in the inset in Fig 113 were melting away large bodies of water drained to Lake Warren in the south west. Between Galt and Elora these ice-drainage channels can readily be picked out on the topographic maps. They are all *misfits* i.e. broad channels occupied today by trickling streams which would certainly not have carved out the valleys they occupy. Indeed this prevalence of misfit streams is the great characteristic of Southern Ontario. In all cases it indicates that the present day drainage is far less abundant than in the times of the waning Ice Age when the main valleys were excavated in the mantle of Till.

The ice lobes in the east covered much of the Niagara Cuesta but near Orangeville (Or in Fig 113) they only just reached it. Here accordingly the piles of moraine deposited by the western margin of the Ontario lobe (inset Fig 113) have nearly obliterated the cuesta. Further south near Guelph the moraines are well to the west of the cuesta edge. Hereabouts are some fine examples of cross-channels in the edge of the cuesta due partly to erosion by ice waters but also over-deepened to the typical catenary curve by moving ice. For instance west of Milton such a cut off (or cross-channel) separates Rattlesnake Point from the main cuesta. Another similar example is to be found thirteen miles north of Milton. Such cut-offs are much more abundant in the analogous glaciated region *south* of Lake Ontario near Syracuse.

Between the two ice lobes indicated in the inset in Fig 113 an elongated mass of tumbled moraine was built up which extends from the cuesta eastwards beyond Rice Lake. This is a marked feature as one travels north from Toronto to Aurora. It is sometimes called the Oak Ridges Moraine but since it forms the main divide in this area I have labelled it the Moraine Divide in Fig 113. It is full of small lakes such as Bond Lake and Wilcocks Lake. Another series of horse shoe moraines surrounds Lake Ontario but they are not so striking as those surrounding Ontario Island.

The lakes at a later stage in the waning Ice Age occupied a much larger area than at present. An ice lobe for a time blocked the St Lawrence Valley near Kingston and the waters of the Upper Lakes reached Ontario *via* the Trent Valley. At this time Lake Huron extended far east of Georgian Bay and included present Lake Simcoe as well as the western Kawartha Lakes. This stage of the lake is known as Glacial Lake Algonquin. Lake Simcoe is the last relic of this former extension of Lake Huron. Much of the rich farm land

PLATE IV

TRAVERSE OF CENTRAL CANADA



9—Glacial Grooves on Shield
Hollinger Gold Mine Timmins



10—Burning muskeg near Opatatika in
Clay Belt west of Cochrane



11—Smooth Rock Paper Mill near
Cochrane Ont.



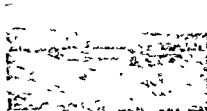
12—New farm on Shield White River
150 miles north of Sault Ste
Marie



13—Kenora typical soil and forest on
the Shield



14—Gregg 100 miles west of Winnipeg



15—Medicine Hat Flood Plain of
South Saskatchewan



16—Turning on irrigation water Leth
bridge Alta

west of Lake Simcoe is due to the silts laid down in former Lake Algonquin⁷

At that time Lake Ontario was about 200 feet deeper, before the ice dam vanished from the St Lawrence. The enlarged lake is called "Glacial Lake Iroquois," and its old shore line is one of the most interesting features to be seen in the City of Toronto. The land north of a line (the 'hinge line') joining London to Manistee (Michigan) has been tilting since the ice load vanished (Fig 113). The once level shore line of Lake Algonquin has gradually risen 150 feet within the distance shown by the line *a, b* in Fig 113. This remarkable elevation within the last 20,000 years or less has certainly affected the rivers of the Trent system and no doubt in part accounts for the curious string of lakes known as the Kawartha Lakes.

There are many interesting problems indicated along the shores of the Great Lakes. On the north side of Lake Erie there are two contrasting coasts, which I have labelled "*Chine Shores*" and "*Scallop Shores*". The former occur where the coast is being cut back rapidly by the waves, so that the little streams cut deep chines or ravines. The beautiful examples, nearly 200 feet deep, near Scarborough are classic. The scallop shore is much lower, the waters are shallow, and the coasts exhibit an alternation of small bays and capes. The debris cut from the chine shores is piled up to leeward in the form of sandy hooks. Examples are obvious at Toronto, Erie (Town), and Rondeau Point. Long Point is so much bigger that it probably has a somewhat different origin, perhaps depending on the immense amount of moraine reaching the lake hereabouts. It indicates a local current moving to the east, and it is filling up the deepest part of Lake Erie. The origin of this huge sandy hook is only one of the many features needing further research. The sand and shingle bars which pile up at the ends of a large lake are well shown at Hamilton. The Burlington Bar belongs to the present lake cycle. The remarkable inner bar about five miles west, towering 120 feet above the lake, was formed in the same fashion when Lake Iroquois was in existence (Fig 113).

C Topographic Control in the Vicinity of Toronto⁸

The block diagram given as Fig 114 has been drawn from the

⁷A valuable discussion of the soils of Ontario with their bearing on settlement, will be found in Putnam and Chapman's recent pamphlet 'The Physiography of South Central Ontario' (*Scientific Agriculture* May, 1936).

⁸This section on Toronto is inserted to show that environment dominates the evolution of cities—as well as of regions.

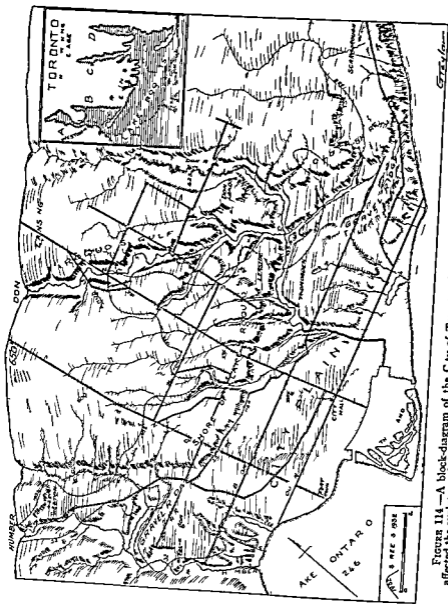


Figure 114—A block-diagram of the City of Toronto showing the topographic features which have affected the evolution of the city. Inset is a diagram showing the locality at the Lake Iroquois period. The fine line labelled 1932 shows the edge of the streets with close-set houses in 1932. The

contours given on Dr Coleman's invaluable Pleistocene map,⁹ and I have had the privilege of discussing this section with him. In the whole area bed rock appears only along the floor of the Humber Valley near the Weston Road and Bloor Street. In the northern part shown in Fig 114 the mantle of glacial Till is usually 300 or 400 feet thick while on the "City Plain" it is about 40 or 50 feet thick over the Ordovician shales. Since the present lake level is 246 feet above sea level and the highest point indicated is about 650 feet, the diagram shows a range of elevation of about 400 feet.

The inset map in Fig 114 shows us the topography of Toronto in the waning Ice Age. Lake Iroquois was nearly 200 feet higher than the present Lake Ontario, and covered the City Plain. The present shore line with its sandy hook (the "Island") is shown by broken lines in the inset map. But the waters of Lake Iroquois also entered far up the valleys of the Humber and Don (which had possibly been cut deeper than they are now *before* Lake Iroquois time, and had then been filled up to the 425 feet base level). In that early period further developments occurred. The waves tore off debris from the Scarborough Cliffs and piled them up to form a gravelly hook, exactly like the present "Island". This is marked on Fig 114 as the "Gravel Ridge" four miles east of the City Hall. So also the cliffs below Upper Canada College (*U C C* in Fig 114) furnished debris to build up a gravelly bank, where St Clair Avenue reaches the Humber. These two gravel ridges caused the deflection to the west of the Humber Black Creek and of the two Don Rivers. These ridges are shown near *E* and *F* in the inset map. The four gulfs in the Lake Iroquois shore line are labelled *A, B, C, D*, in the inset map. That shown at *C* is the most impressive, with its present stream (a palpable misfit) meandering across the flat floor of the "Iroquois Gulf". I have inserted the latter name on the larger block-diagram because it has been an important factor in the evolution of Toronto.

As the waves of Lake Iroquois beat on the confining shores they cut out the well known "Iroquois Shore-line," which runs west-east between the 425 and 450 contour lines in the topographic map. It can easily be picked out on the larger diagram (Fig 114) with the help of the inset map. Obviously when the lake level was near 425 feet, the rivers would tend to deposit Till up to this level. Hence the

⁹A. P. Coleman *The Pleistocene of the Toronto Region* (Annual Report of the Ontario Department of Mines vol. XLII part 7, 1932)

ravines so common to the south east and south west of Upper Canada College are *flat bottomed* with floors at about 425 feet

Toronto, like most cities of the Victorian age, evolved without a scientific plan. The primary land divisions in Canada often ran at right angles to the lake shore without the slightest regard for the natural topography. The main roads naturally ran along the concession lines. It so happens in Toronto that the main valleys and ravines enter the lake somewhat diagonally. Those connected with the Don have an average direction about N 56° W, while the chief roads run N 16° W. Hence the orthodox "chessboard" design cannot possibly fit the topography. The instinct of the Indians was better. Their trails connected point to point by the easiest route, and this never produced a "chessboard" design. Since in cities most people wish to reach the civic centre, it is much wiser to copy the spiderweb for the road plan, and some of the earliest roads in Toronto such as the *Dundas, Davenport, and Kingston Roads* did in part lead straight to the centre of settlement. Vaughan Road and Old Forest Hill Road are two later roads which follow the natural line of least resistance, i.e. along the divides between the ravines.

Toronto first comes into history in September, 1615, when Brulé traversed the Indian trail from Holland River southward to the mouth of the Humber. This traverse was the famous "Carrying Place," a portage of some twenty-eight miles between the Ontario and the Huron streams. The Iroquois at this time controlled the country near Lake Erie and not till 1665 did the French explore the Toronto region at all thoroughly. They found that the Senecas had a small village at Tei an agon on Baby Point (Fig. 114). In 1673 Frontenac built his fort at Kingston, and La Salle traversed the Carrying Place three times about 1680. Fort Rouillé was erected in 1751 where Dufferin Street now reaches the lake. It was burnt in 1759 to prevent it falling into British hands. The Indian Trail is shown in Fig. 113.

Independent traders like Rosseau and Baby soon opened stores near the mouth of the Humber. Meanwhile it was believed that the first capital, Newark (Niagara), was too near the United States, and the harbour at Toronto was chosen by Lord Dorchester. It had been surveyed as a site for an arsenal by Aitkin in 1788. In May, 1793, Governor Simcoe reached Toronto, and the fine oaks at the head of the harbour seem to have determined the position of the little settlement. Aitkin laid out the first streets in 1793, the two named first naturally being King Street and George Street. This intersection

is about half a mile east of the City Hall (Fig 114) Most of the shore line to the west was made a military reserve Aitken's survey indicated Queen Street (formerly Lot Street), and divided the region north of this line into the usual blocks of one and a quarter miles square All the main streets, such as Yonge, Bathurst, and Dufferin, and even later streets like Bloor, St Clair, and Eglinton, have been based on this early subdivision by Aitken All these roads will be found to border blocks of the type mentioned above A valuable description of the method of making land grants and of laying out towns in Ontario will be found in Schott's *Landnahme und Kolonisation in Canada*¹⁰

Toronto's predominance is, therefore, due to the combination of the Indian trail and the harbour In common with most important towns on lake fronts, Toronto's wharf line has experienced remarkable changes This is well indicated by the street names Front Street originally ran close to the lake, just as the "Strand" in London once fringed the river swamps But the later water-fronts are indicated by such names as Esplanade, Fleet Street, and Queen's Quay The Esplanade was finished about 1863, partly as the result of the needs of the new railways All this "made ground" has left Front Street nearly half a mile behind the present water front The original lagoon to the east (except for a turning basin for ships) has been almost entirely filled in¹¹

D Settlement and Crops in Southern Ontario

The migration of thousands of British Loyalists to Canada was a natural result of the War of American Independence A number of isolated regions were first settled on the margins of the old established French occupation Some Loyalists built their homes along the fertile St John Valley, others, as we have seen, went to the Eastern Townships, both just across the border Catholic Highland regiments founded Brockville and various towns in the county of Glengarry Kingston was an early centre, while Butler's Rangers took up land at Niagara The Mohawks, Indian allies of the British, were given 700 000 acres near Brantford, where their descendants are still numerous By 1789 the Loyalist stock of Ontario had increased to 30 000 persons¹²

¹⁰Kiel 1936 See also the author's *Urban Geography* (London, 1919)

¹¹For details as to the city, see Griffith Taylor, 'Topographic Control in the Toronto Region' (*Canadian Journal of Economics and Political Science* Nov., 1936)

¹²H Cory *Modern Canada* (London 1930)

Many actual American emigrants came in later. Thus Philemon Wright erected the first timber mills at Hull in 1800. Many military officers came to Upper Canada such as the Irish Colonel Talbot who founded London. Others settled near Perth and Lake Simcoe. In 1815 the district near St. Thomas was occupied by disgruntled emigrants from the Red River region in Manitoba. Guelph and Goderich were founded by the Canadian Land Company in 1827. About this time there were 158 000 in Upper Canada (Ontario) and 479 000 in Lower Canada. But the newer province was going ahead much more rapidly so that by 1837 the population of Ontario was 400 000 not so far behind the 600 000 of Lower Canada.

Crops vary more strikingly on a north-south traverse than on an east-west primarily because of temperature controls. In Fig. 115 some of the more important limits in or near Ontario are charted. Point Pelee which projects into Lake Erie is the most southern point in Canada and along the lake shore tobacco can be grown successfully since the July temperature is 72°. It is little matter that in January the temperature is 8° below freezing. Vines flourish near the Niagara River and a specially well favoured district lies between the Silurian cuesta and Lake Ontario. Here at Grimsby and St. Catharines are many orchards and the locks of the new Welland Canal raise the wheat steamers 326 feet from one lake to the other.

The fertile southern portion of Ontario is noted for oats, hay and dairy produce generally.¹³ The centres of these crop areas are often termed *Optima* and some of these are charted in Fig. 115. The growing industrial region of Canada is developing between Montreal and Windsor with many factories at Oshawa, Toronto, Hamilton and other notable towns. The power is largely derived from Niagara, Shawinigan and other smaller hydro-electric plants. Coal must be obtained either from the United States or from Britain though there is a natural attempt to increase the use of coal from the Maritimes.

E Characteristics of the Laurentian Shield

The next stage of our continental traverse takes us from Ottawa *via* Toronto and the Clay Belts to Fort William and Kenora. Ottawa is the Dominion capital near the Chaud ère Falls on the Ottawa River. The city has however no Federal Territory surrounding it but is situated in Ontario. To the north the Shield rises abruptly from the

¹³H. A. Innis (ed.) *The Dairy Industry in Canada* (Toronto 1937)

river, forming steep slopes which represent an old fault-plane To the south are undulating Ordovician deposits which carry prosperous farms¹⁴ The Rideau Canal traverses this region to Kingston It was a costly enterprise built in 1826-32, when fear of the Americans dominated Canada¹⁵ Today the Rideau Canal furnishes power to a few small mills, but is chiefly used by tourists The same remarks

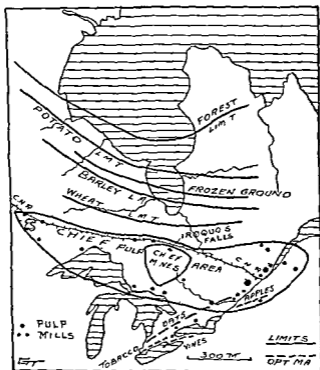


FIGURE 115—Some of the chief agricultural and industrial limits in the region north of the Great Lakes (Partly after L. Mecking)

apply to the longer Trent Canal, which links Trenton with Georgian Bay by way of Peterborough, the Kawartha Lakes, and the Severn River These canals are indicated in Fig 117

Travelling westward along Lake Ontario through many orchards

¹⁴This feature is illustrated in Plate III Photo 4.

¹⁵One of the block houses to protect the locks at Merrickville is photographed in Plate III, Photo 5

and farms Toronto is reached, where we turn northward towards Lake Simcoe. At Aurora the unusually high mounds of glacial debris mark the *medial moraine* between the two great ice lobes (Fig 113). There is a striking break in the character of the settlement when the Shield is reached. The boundary runs from Port Severn on Georgian Bay across the top end of Lake Simcoe and so by way of the Kawartha Lakes and Madoc to Gananoque on the St. Lawrence.¹⁶ To the south is a complete *road net* with close set farms; to the north are few but main highways and rather scattered roads leading to widely dispersed farms (Photo 8 on Plate III). The glacial debris on the Shield seems to be arranged in a much more haphazard fashion than in Southern Ontario and the drainage pattern is extremely complicated. Hence the prevalence of countless small lakes and of ill-defined divides between the various river systems (Fig 12 at H).

The Shield is of course the habitat of the spruce and of other conifers which furnish the pulp of the colossal paper industry of Canada. The larger pines were cut out in the early days of lumbering and many of the genera of conifers are too resinous to be acceptable for paper at present. Everywhere near the main railways and rivers or Great Lakes paper mills may develop in the southern portion of the Shield. Thus at Iroquois Falls the paper mill supports directly and indirectly some 5 500 people. But Professor Lower¹⁷ thinks it unlikely that the local farming population which now provides much of the labour and stock required by such large mills will ever be a large proportion of the population of the Shield.

In Fig 115 the paper pulp region is shown as it is today extending very little north of the great east-west Canadian National Railway. Indeed to the north the size and quality of the timber diminish rapidly. Nowadays the regeneration of the forest is being carried out while it is actually being cut for pulp but it is not very successful to date.¹⁸

To the north of the Canadian National Railway certain hypothetical limits have been plotted in Fig 115. These are taken from a

¹⁶A bare portion of the Shield with large erratics of granite is illustrated in Plate III Photo 7.

¹⁷A. R. M. Lower and H. A. Innis *Settlement of the Forest and Mining Frontier* (Toronto 1936).

¹⁸The paper mill at Smooth Rock (near Kapuskasing) is photographed in Plate IV Photo 11. The huge pile of logs often 50 feet high can be made out on the right.

diagram by Ludwig Mecking¹⁹ We see that permanently frozen ground is found as far south as the shores of James Bay, but potatoes can be grown north of this important limit Barley also is much more capable than wheat of being grown successfully in these cold northern latitudes The boundary between the forest and the tundra (Fig 115) is not far from latitude 56° on the shores of Hudson Bay

Many farms, however occupy the hollows in the by no means uniformly sterile areas of the southern part of the Shield Nor is the Shield particularly level, as is best shown, perhaps in the famous nickel region north of Sudbury The block diagram (Fig 116) shows a large boat shaped basin some thirty miles long This hollow is

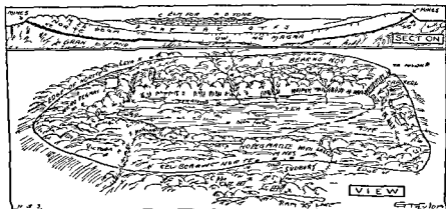


FIGURE 116—A block-diagram of the Sudbury Basin (30 miles long) eroded from the ancient rocks of the Shield owing to the softer character of the upper Animikie slates A vertical section through the syncline is given above (From a model prepared under the direction of Professor E S Moore)

bounded by steep slopes several hundred feet high, which are composed of Precambrian rocks hardened by contact with eruptive rocks of later date The latter (Pegmatite and Norite) welled up in a molten form from below, and then spread out in a vast boat shaped mass, lifting up the softer Animikie slates As the molten rock cooled the heavy nickel minerals fell to the lower parts of the mass The layer rich in nickel is shown black in the section above Fig 116 Hence the nickel mines today are found all round the oval margin Frood, Victoria, and Levack are three such mines shown in Fig 116

¹⁹Geography of the Polar Regions (New York 1928)

North of Sudbury, which produces 80 per cent of the world's nickel, is one of the richest mineral fields in America. Untouched iron deposits of great extent are known at Moose Mountain near Sudbury. Eighty miles north is Cobalt, a great silver and cobalt field. To the north are Kirkland Lake and Rouyn (Quebec), while the greatest gold mine of all is Hollinger at Timmins. To the end of 1932 the two fields of Porcupine (around Timmins) and Kirkland Lake produced gold worth more than 433 million dollars.

The Hollinger mine was discovered in 1910, and owing to the high price of gold it pays to put large masses of the "country rock" through the mill, since gold in small amounts permeates large areas. Around the town are mounds of tailings, and many of the valleys are being filled with similar waste from the crushing mills.²⁰

F The Clay Belts

More or less surrounding this notable mineral region is the chief Clay Belt. As the front of the great ice cap melted away (for the ice did not actually retreat, as often stated), gradually the "Height of Land" was freed of ice. Thereafter the water was ponded to form a lake between the divide and the ice front (cf Fig 119). This lake gradually extended over huge areas of the Shield, and has been named "Glacial Lake Ojibway". In these temporary lakes which, however, lasted for thousands of years, vast masses of silt and clay were deposited on top of the Shield and its moraine heaps. The main area of the clay thus deposited covers 16 million acres in Ontario and 14 million acres in Quebec.

It is clear since the Clay Belt is so far north, that agriculture, though possible cannot be easy. The soil is deeper and more fertile than most of the loose debris on the rest of the Shield. But difficulties of drainage are considerable in these rather level areas of stiff, cold clay. It is found that the farms on the *slopes* of the scattered rocky knolls do the best. The autumn is often rainy, making harvesting an uncertain matter. Frosts are likely to occur and harm the crops even in June. Moreover, there is the constant rivalry between farming and gathering pulp-wood. A new settler on his so-called farm of 160 acres can cut and sell \$50 of logs per acre. It is a temptation to clear

²⁰Rocks close to the original discovery at Hollinger are photographed in Plate IV Photo 9. Grooves worn in the granite by the former ice cap can be made out in the foreground.

the spruce and poplar off his land-grant, and then move to a new locality, and there harvest another "crop" of pulp-logs!

The Government is wisely opening up sections in proximity to each other, so that no blocks *westward* of Hearst are yet available. Indeed, all road traffic stops here, as it does farther south near Sault Ste. Marie. Hence the great break in the roads across Canada is not in the Rockies, but on the relatively level Shield east of Lake Nipigon. A good deal of work, involving much heavy blasting, has been done on the section from Nipigon to White River. Whether the Trans-

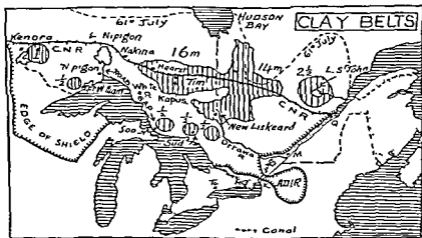


FIGURE 117 — Map of the Laurentian Shield showing the Clay Belts and other agricultural regions. The figures give approximate areas in millions of acres. Notice the sole gap in the roads across Canada at Nipigon. (Partly after A. R. M. Lower)

continental Highway will go north from this place to Hearst, or (as seems more logical), south to Sault Ste. Marie, is not yet certain (Fig. 117). (In 1943 a new road linked Nipigon and Hearst.)

A glance at Fig. 117 will show that these Clay Belts large and small add up to the respectable total of 36 million acres of possible farmland. All of this is within the Shield with soils better than its usual average. It is a mistake, very generally made, to think of the Shield as *rocky*. Some geologists put the area of bare rock as low as 3 per cent. In truth, we must learn to think of it as an area of forest and *muskeg*. The latter is marshy area overgrown with sphagnum moss, etc., and containing much poor spruce and allied conifers. In the low coastlands around James Bay the country is so ill-drained that forests

are said to grow best only alongside the large rivers, where the ground is a little drier. The rest is mainly muskeg. The pioneer drains the marshy land, cuts the timber and then burns it. Much of the muskeg moss burns also as is seen in Plate IV, Photo 10.

White River is an interesting settlement based chiefly on railway needs. Here cattle on their eastward journey usually halt for a rest. Here also are railway repair shops and a relay station on the telegraph system. But there are also many small farms, though it has no claim to be on a Clay Belt, and is said to be the coldest place in settled



FIGURE 118—The structure of Lake Superior showing the fault blocks (Horst and Graben) which help to build it. (Partly after F. B. Loomis) (Atitokan should be Atikokan)

Canada. The average temperature in January is 32° below freezing and the average for the year is just 32° F. Potatoes, oats, and turnips are the chief crops, and many vegetables do well. The obvious drawback is the lack of market. Possibly this difficulty worried settlers in Poland about the thirteenth century.¹ To a geographer familiar with the empty lands of arid Australia, such pioneer places as White River seem to have distinct possibilities.²¹

The Canadian Pacific Railway runs along Lake Superior west of White River. Here the many rocky promontories are picturesque rather than promising for settlement. Halliday²² points out that conditions along the lake are colder than usual since *Boreal forest*

²¹A characteristic picture of soil and small trees on the Shield is given in Plate IV Photo 13. A farm at White River is photographed in Plate IV Photo 12.

²²Op. cit.

replaces the usual lake timbers (i e , maple and birch) here At Fort William is one of the most interesting traffic towns in the world Here are twin cities, for Port Arthur is only five miles north on a wide plain Most of the thirty six gigantic wheat elevators have been erected at Port Arthur where frontages to the lake were cheaper Here again enterprising farmers are growing hay and potatoes, and making a success of it

The western end of Lake Superior is marked by several fault-blocks (Fig 118) The promontory containing the copper fields and the Penokee Range is a Horst, while the two bays east of Duluth are sunken areas or Graben²³ The undulating landscape of the Shield extends westward to beyond Kenora Thousands of lakes make this a holiday land for folk from the United States and Winnipeg Valuable mines of iron at Steep Rock near Atikokan, of gold at Red Lake and Sturgeon Lake, and of silver near Port Arthur indicate the mineral wealth of the ancient Shield Then at Whitemouth, about fifty miles east of Winnipeg, the fields of grain show that we are entering quite a different structural unit

²³F B Loomis *Physiography of the United States* (New York 1937)

CHAPTER XXIV

STRUCTURE AND SETTLEMENT IN THE PRAIRIE PROVINCES

A General Structure of the Prairie Provinces

While the region between the Shield and the Rockies is often referred to as the Great Plains the contour map (Fig 104) shows us that there is a constant increase in elevation from Winnipeg at 763 feet to the foot of the Rockies at 5 000 feet Early travellers across the plains noted two well-defined "rises" which are in large part *cuestas*, i e., the outcrops of hard layers in the great basin like area between the Shield and the Rockies There are thus three stages in the ascent to the Rockies The first stage (Fig 103) is the lowest, and includes the area, about 1,000 feet high, once drowned by Glacial Lake Agassiz¹ This is bounded on the west by the marked *cuesta* of younger Cretaceous rocks which stand out as the hills called Riding, Duck and Porcupine Mountains These hills are 'Outliers' isolated from similar deposits to the west by the broad valley of the Assiniboine River In the United States this scarp is called "Coteau de Prairie"

The second level or stage is about 1,500 feet high, and extends from the Cretaceous *cuesta* to the 'Missouri Coteau' near Moose Jaw Here occurs a capping of Tertiary rocks (Fig 103), which builds up Wood Mountain and the Cypress Hills, both near the International Boundary The Cypress Hills rise 2 000 feet above Medicine Hat The third stage (2 000-5 000 feet) extends from the 'Coteau' (a French trapper's word, akin to the Spanish word "*cuesta*" and both meaning a *scarp*) to the foot of the Rockies

The structure is therefore much simpler than that of the regions of the east or west In Manitoba the Shield covers the north and east (Fig 119) but in the south west part of the province the surface rocks are deposits of the same age and character as those near Toronto There is a regular sequence of Ordovician, Silurian and Devonian formations much as we saw in that region But the silts of the Glacial Lake have covered most of these rocks so that it is necessary to journey twenty five miles north of Winnipeg to find solid rock as

¹Pronounced Ag' a see

at Fort Garry As Dowling² states, the large lake basins are due mainly to the removal of the Paleozoic rocks (Ordovician, etc.) from the underlying westerly dipping surface of the Shield We may perhaps call these lakes from Winnipeg to the Great Bear 'Cuesta Lakes' (Fig 103), like those of Ontario and Michigan

The greater part of the Prairies consists of upper Cretaceous deposits (*Montana Group*) These are divided into the *Pierre Shales*, which are widespread in the east, and the *Belly River Sandstones* and shales which are found more abundantly in the west In Central Alberta a third set of deposits, like those of Belly River, is called the *Edmonton Series* Coleman and Parks³ state that the conditions of shallow and brackish water, under which the Belly River and Edmonton deposits were made, favoured the formation of layers of coal Owing to the relatively short lapse of time and the lack of severe terrestrial disturbance since the deposits were formed, coal evolution has not proceeded beyond the earlier stages In consequence, nearly all the coal is lignitic or sub bituminous Dowling believes that there are reserves of coal amounting to 223 thousand million tons in the Belly River formation of which Lethbridge is the chief producing centre In the Edmonton formation he thinks that there may be 800 thousand million tons of coal in reserve Drumheller is the chief coal area in this field (These estimates are now much reduced)

In the very earliest Tertiary times there were laid down various soft sandstones and shales, which contain a good deal of coal in the form of lignite This is worked near Estevan and Wood Mountain in Southern Saskatchewan But it is so friable that it does not stand transportation, unless it is hardened by being made into briquettes

B *Environmental Control in Manitoba*

Few examples of the control of population by structure are more striking than Manitoba The early settlement and present and future prosperity of the province are largely due to the effects of a remarkable phase in the glacial geology It is not too much to say that settlement in Manitoba is almost wholly a development based on Glacial Lake Agassiz During the wasting away of the great ice cap, it occupied for long periods of years positions like that sketched in

²*Transcontinental Geological Guide* part 8 (Ottawa 1913)

³*Elementary Geology* (Toronto 1930)

Fig 119 As a result the waters of the Red River were held up in the form of a giant lake

Lake Agassiz covered about 80 000 square miles whereas Superior is only 31 500 square miles For a time it spilled over at Lake

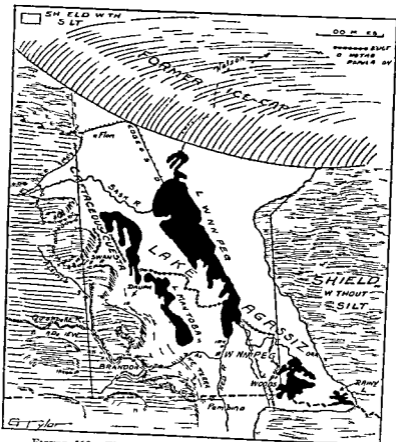


FIGURE 119—The topography of Manitoba showing Glacial Lake Agassiz. The hypothetical position of the ice-dam is indicated. The edge of the Shields shown but it is sparsely covered with lake silts in the east (shown by dots) (Partly after Coleman and Downing)

Traverse (Fig 104) and drained to the Mississippi. At Winnipeg the depth of water was about 560 feet⁴ and ancient beaches are well

⁴Downing op cit

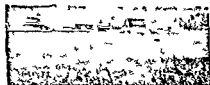
PLATE V

TRAVERSE OF WESTERN CANADA



17 Lethbridge showing coal fields on the river bluff

18 Indian log house muskeg on roof Cheecham North Alberta



19—A northern oats crop Prairies near McMurray North east Alberta

20—Athabasca boat and barge at Waterways looking east



21 Where Prairies meet the Rockies Cochrane near Calgary

22—Kicking Horse Canyon near Felling



23—Terrace of Thompson River near Alberta B.C.

24—Kanloops Lake (single shown foreground)

preserved on the western margin (Fig 119) These are not level now, which proves that warping accompanied the wasting of the ice sheet. An outlet to the north arose when the water was 240 feet deep over the site of Winnipeg. In the earlier phases the lake extended eastward to Rainy Lake but in this eastern portion the silts laid down in the calm lake waters, were never deep. The deeper and better soils occur in the western part of Lake Agassiz with Winnipeg as their centre. Lake Winnipeg is the last relic of Glacial Lake Agassiz.

Southern Manitoba lies on the border of the grass lands and the Boreal Forests i.e. just where the tree zones have advanced or retreated as the post glacial climate grew warmer or colder. According to Halliday,⁵ aspen (*Populus* sp.) is the characteristic tree, though Balm of Gilead (also *Populus*) and bur oak are common. White birch and white spruce are found in the "relict woods" left on the northward march of the Boreal Forests as the ice zone retreated. These northern types are abundant on the hills south west of Winnipeg. Around Lake Winnipeg the marshes and gravel ridges are covered with black spruce and larch. The soils here are rather rich in lime due to the bed rock being largely Palaeozoic limestones.

As far west as Rainy Lake the topography exhibits the normal features of the Shield. But to the west of this lake the mammilated rock surface of the Shield is more and more covered by silts rather than by glacial Till. Only in the western portion of Lake Agassiz were the silts deposited so deeply as to cover over all inequalities. Accordingly around Pembina and Winnipeg is one of the finest agricultural areas in the world. The boundary of the good farm land agrees fairly well with the eastern edge of the Palaeozoic rocks. But only occasionally near Winnipeg do these Palaeozoic rocks outcrop above the silt.

To the west of Pembina the rather well marked scarp as stated, is the cuesta bounding the enormous area of Cretaceous strata, which build up the larger part of the Prairies. This Cretaceous cuesta extends north to Flin Flon, where the Shield once more outcrops (Fig 119). Here one of the best copper zinc mines in the Dominion is situated, just at the boundary of Manitoba and Saskatchewan.

The most interesting features along the cuesta are the striking lake terraces, which were cut in the Cretaceous shores at different levels of the Glacial Lake. North of Dauphin four of these terraces can be seen like great steps, each about 40 feet high and about one

⁵Halliday. A Forest Classification for Canada. *op cit*

mile apart. The Assiniboine River has cut rather deeply into the Cretaceous mantle and Dowling points out many interesting deflections of drainage since Ice Age times. For instance the channels of the Qu Appelle and of the Pembina formerly carried far more important rivers than they do today.

The first farming settlement in the Prairies was made near Selkirk in 1812 by Scottish farmers who reached the district by boats from Hudson Bay. But until 1870 the fur trade reigned supreme. In 1871 the new Province of Manitoba contained 12 000 inhabitants of whom 10 500 were half breeds.⁴ By 1881 there were 279 000 acres of prairie land under cultivation. Today there are over 15 million acres occupied and the population of the province is over 700 000. The cultural composition of the immigrants is discussed later.

At the present time the farming population is fairly dense on the Cretaceous mantle in the west. It spills down the re entrants of the cuesta at Swan River, Dauphin and Brandon but leaves the forested hills of the actual cuesta almost empty (Fig 119). From Swan River the edge of settlement runs to the south east nearly to Kenora but for the most part keeps away from the sparsely sited portion of the Shield which is shown in the sketch map by dots.

C Saskatchewan and Alberta

In this great area of new settlement structure is relatively unimportant since the region is covered with a vast extent of nearly level Cretaceous rocks. Only in the south are there moderate elevations like the Cypress Hills. Hence other environmental controls such as climate and soil become of more importance.

One of the most valuable advances in geographical knowledge was made when it was realized that soils depend more on rainfall than on the underlying rocks. If we examine a soil map of the United States or Russia where the most detailed work has been done we find that the soil isopleths agree fairly closely with those of the annual rainfall and to a much less degree with the limits of the various rocks.

This close relationship is due to the fact that in a mature soil is one which has been in the same position for long periods of time various physical and chemical changes occur which are much the same in all decomposed rocks with the same environment.⁷ In *normal*

⁴W. A. Mackintosh *Prairie Settlement* (Toronto 1934)

⁷For a general discussion of soils with a diagram correlating rainfall and soils see the writer's paper in the *Geographical Review* New York Jan 1933

climates with good rainfall the more soluble salts are washed right away, while the less soluble clay and iron are dissolved out of the upper portion of the soil and deposited in the lower layers. In *arid* climates the more soluble constituents, like the lime, gypsum, and salt, change their position in the same way. With intermediate rainfalls are found the best soils, usually much enriched by humus, which gives them a dark colour. Finally we obtain a relationship which can be expressed in a very much generalized way in the following table. It refers mainly to the United States.⁸

Rainfall		Temperature	Soil	Locality	Character
Inches	Type				
15-40	Uniform	Cool	Gray Podsol	Maine	Poor
35-42	Uniform	Warm	Brown Podsol	Ohio	Fair
42-60	Uniform	Hot	Laterite etc	Florida	Poor
25-35	Summer	Warm	Prairie soils	Iowa	Good
15-25	Summer	Warm	Black Chernozem	Kansas	Very good
10-15	Summer	Warm	Brown steppe	Montana	Good
Under 10	Summer	Warm	Gray desert	Nevada	Poor

In the Prairie Provinces four of these divisions occur. The annual rainfall is given in Fig. 120, and ranges from 11 inches in the south



FIGURE 120 — *At left* Rainfall map of the Prairies with the limit of the Coal Measures as a heavy line

At right Population density in the Prairies (1931)
(Both maps based on the *Official Atlas*, 1931)

west to 20 inches in the south-east and in the mountains. The soil divisions are shown in Fig. 121, which is based on the *Official Atlas*. The richest soils (black) are in part due to the deposition of the silts in Glacial Lake Agassiz. The Gray soils are *Podsols* in which most of the plant food has been dissolved (leached) out by the rains, giving an

⁸See Finch and Trewartha *Elements of Geography* (New York 1936)

ashy colour as the Russian name implies. The Dark Brown soils are the *Chernozems*, the best of all for crops, and in the Prairies they occur where the rainfall varies from about 14 to 19 inches a year. Under such conditions the rainfall is not heavy enough to leach out much of the soluble plant food, yet it is sufficient for grasses, whose roots decay and gradually add rich humus to the soil. The Brown soils are also very good for crops and are found where the rainfall is about 14 inches a year. The Gray Brown steppe soils occur where the rainfall is as low as 13 or 14 inches.

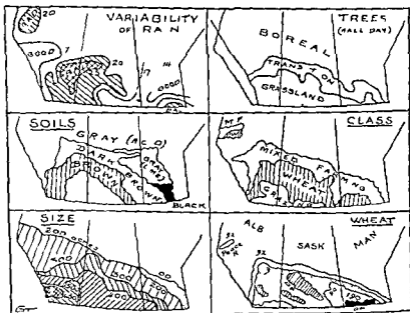


FIGURE 121—Various distributions in the Prairie Provinces. The variability shows percentage variations from the average. The darker soils are the most fertile. The wheat map shows the margins of the wheat belt in 1901, 1911 and 1921. The densest wheat (optimum) in 1901 is black and in 1921 is ruled. (From the *Official Atlas* 1931.)

Of course the rainfall also determines whether grass or trees shall cover the country. In the Prairies the boundary is near 14 inches, so that the Brown and Gray Brown soils (Fig. 121) are mostly grass land, while the Dark Brown and Gray soils are mostly forested but with plenty of patches of grass land in the south.² In the Transition

²See Halliday *op cit*.

Belt (Dark Brown soil) aspens and other poplars are the typical trees. To the north (Gray soils) is a mixed wood consisting of aspen white spruce (*Picea*) white birch (*Betula*) and balsam fir (*Abies*). The sandy areas grow jack pine (*Pinus*), while in the numerous muskeg (marshy) districts are *Sphagnum* bogs with black spruce and larch.

The considerable changes in climate soil and vegetation are naturally paralleled in the character of settlement. This is shown in the small map labelled Class (of farming). The Grass lands to the south are too dry for crops unless irrigation is available. The northern edge of the Grass land and also the Transition Forest is occupied by the great Wheat Belt of Canada. The climate on the edge of the Boreal Forest is warm enough for a great deal of mixed farming including dairies roots oats etc. as well as some wheat.

As in all regions of low rainfall the rain is variable from year to year. The greatest variability (over 25 per cent) is found in south east Alberta from Wainwright to Medicine Hat. The best part of the Wheat Belt from the point of view of reliable rainfall appears to be in the vicinity of Brandon where the variation is only 14 per cent. Mackintosh in his excellent account of *Prairie Settlement* also charts the districts where less than 12 inches of rain in the year has been recorded. (This is different from an *average* of 12 inches.) Here again the region near Medicine Hat comes out the worst (Fig 121).

The size of farms is shown in one of the maps in Fig 121. A farmer who depends on grazing needs larger areas than one who grows wheat or who has several sources of income. Hence the farms become progressively smaller as we pass from the south west to the north-east of the Prairies. In the Transition Area (or Park Belt) a half section farm (i.e. 320 acres) is the average but on the open Prairies the farms are often twice this size.

Before the railways settlement in the West was notable only around Edmonton Prince Albert and Battleford and the settlers were largely half breeds. The first railway reached Winnipeg in 1878 and the Canadian Pacific Railway crossed the continent by 1885. By 1901 branch lines led to Edmonton and Saskatoon and by 1911 a direct railway linked Winnipeg to Edmonton. Thus the early influx of settlers before 1901 was mainly into the southern drier portions of the Prairies. The Canadian National Railway traverses much better soils on its more northern route and the great influx of foreign immigrants in the last few decades has been into these northern frontier areas. At that time these partly forested lands were thought to be

less attractive than the open lands already settled by Britishers. This is well illustrated in the map showing present population density. The four large areas with more than ten people to the square mile (shown in black) are found in the newer lands with the more fertile soils and with rather larger and more reliable rainfall (Fig 120). It is in Southern Alberta and in Southern Saskatchewan that the greatest losses of recent years through drought and soil-drift have occurred.

D Turn Towns on the Alberta Frontier

Some brief notes of a journey made by the writer in July 1936 far north of the present edge of notable settlement will indicate how the frontier advances. From Edmonton it is 305 miles to Waterways (Fig 122) and a train went north to the rail-end once a week. Waterways is the river port for the Mackenzie River and the Arctic Territories.

For some 30 miles north of Edmonton the country is undulating and largely converted into farm lands so that the little town of Bon Accord has custom for four wheat elevators. Around Egremont the region is flat but still largely farm land so that this is a three elevator town. But Newbrook, 72 miles north of Edmonton, has only one elevator. The clearings are now scattered and much of the landscape consists of grass below scrubby spruce with many copses of aspen. Boyle (92 miles) is a little larger with two elevators and a hotel.

At Bondiss, a typical marginal settlement, there were twelve families of whom four were on farms. Here they grew barley, oats and some wheat. Forty cows were pastured and the population was mainly Lithuanian and Swedish. The railway station of Noral (112 miles) was an old box-car and two houses completed the settlement.

Lac la Biche at 132 miles is practically the vanguard of agricultural settlement. It is however also a tourist centre owing to the attractions of a picturesque lake. Here are two or three hotels, four stores and a dozen other shops with a large tourist home and a pretty church on the shore of the lake. There is only one elevator and one farm near the town but there are a number of clearings along the railway.

To the north the railway stations serve Cree Indians for the most part. They live in low log houses, sometimes with plants growing picturesquely on the roofs.¹⁰ They are engaged in trapping and catch fish in the creeks and lakes. The landscape near Behan is rather

¹⁰See Plate V Photo. 18

monotonous, consisting of scrubby spruce and muskeg. Conklin is a little larger settlement with two stores and about a dozen Cree houses. On the higher land poplars flourish, the trunks sometimes being a foot in diameter. The train halted for the driver's meals and stopped after dark, so that my journey to Waterways took twenty-seven hours.

It is strange to find *twin towns* in the north of Alberta so far from close settlement. But Waterways and McMurray serve quite different interests. Fort McMurray was founded in 1790 as a North West Company post. It is the larger of the two towns, having a steady

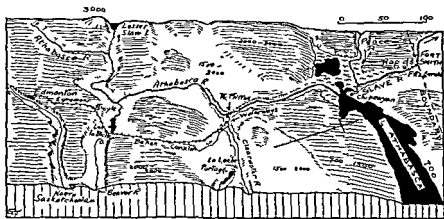


FIGURE 122 —A block-diagram of the Pioneer Fringe north of Edmonton. Farm-lands extend to Lac la Biche, to the north is trapping country. Note the twin towns at the end of the railway. Steamers ply from Waterways to Fitzgerald.

population of 300 as opposed to the 30 who spend the winter in Waterways. But in summer, owing to the greater traffic and the presence of Indian trappers, the populations grow to 600 and 300 respectively.

McMurray consists of one long street with three churches, a fine school, one large hotel, and the Hudson's Bay Store. Half a mile north, on an arm of the Clearwater, is the airport, where three Companies are sending ten planes regularly to the northern mining fields. Environmental control is here illustrated in a curious way, for the wooden offices of the aviation folk are on skids; so that when the river is flooded, owing to ice-jams, they can be dragged away to safer sites. Mr. Brintnall, President of the Mackenzie Air Service, informs me that the air traffic remains fairly constant the whole year round, with the exception of the three weeks mentioned above, and the three

weeks of freeze up in November. It is worth noting that Canada in 1936 carried 25 million pounds of freight by air (mainly mining machinery etc.) far more than any other country, figures for the United States being 7 million pounds.

Trapping is still the main interest of the settlers. I was informed locally that wolves bring up to \$60.00 each, fox \$10.00, lynx \$18.00, mink \$8.00, beaver \$10.00, and otter, \$20.00, while the humble but very important muskrat is worth 60 cents per skin.¹¹

About halfway between the two towns is the settlement of Prairie.¹² Here the oxen of the Hudson's Bay Company used to graze and today there are several apparently flourishing farms at 57° north latitude. At McMurray I saw several acres of potatoes and I was informed that the area always gave good crops to the industrious Japanese farmer who owned them. In the future the abundant tar sands which are now being worked about one mile to the south of the town will aid the development of this district.

Waterways is three miles east of McMurray on the Clearwater River just before it enters the mighty Athabasca. Here are the huge sheds of the transport companies. There are two in addition to that of the Hudson's Bay Company. Scows pushed by small steamers are constantly carrying goods to Lake Athabasca and the north.¹³ The local manager of the Hudson's Bay Company kindly informed me that the shipping season opens in the middle of May and closes in the middle of October. The Company runs three steamers and barges from Waterways. These three can convey 475, 200, and 160 tons respectively. There are also two steamer barge units plying for other companies. All of the above make weekly trips to Fort Fitzgerald. From there the goods are portaged to Fort Smith (Fig. 122) and carried by a 700-ton steamer to Aklavik at the mouth of the Mackenzie River.

Waterways had only one hotel and two small stores. It had no church or amusement hall and for these the citizens took a bus to the City of McMurray.¹ When ice from the Athabasca River is driven up the Clearwater as happens in spring, then the Clearwater may rise some 20 feet above normal, flooding most of the houses and justifying the name of Waterways. It seems unlikely that the railway will soon

¹¹The standard book is that by Harold Innis *The Fur Trade in Canada* (New Haven 1930). See also the author's long account in *Can. Econ. Jnl.* 1944.

¹²See Plate V Photo 19.

¹³See Plate V Photo 20.

be extended to McMurray, since it has reached navigable water at its present terminus

About 40 miles up the Clearwater is the famous La Loche Portage (Fig 122) This was used in the early days to connect the Mackenzie traffic with that of the Churchill and Saskatchewan Basins In 1875 a road for carts was made across the 12 mile portage, but there is little use made of it since the railway reached Athabasca in 1916 and Waterways in 1920¹⁴

E Foreign "Cults" (Culture Groups) in Canada

One of the two insets in Fig 123 shows the number of immigrants entering Canada year by year since 1870 The peak year was 1913 with 382 841 immigrants The graph drops sharply after the war, and again in 1930 owing to the depression The second inset shows the population in the various provinces classified according to parent age (In the graph only the folk having *both* parents Canadian, British, or foreign born are charted) It is clear that only four provinces are of significance in this connexion These are Quebec, owing to its large proportion (80 per cent) of French culture, and the three Prairie Provinces, each with about 40 per cent of foreign origin It is of interest that the settlers on the east coast are largely of British descent derived from *early* migrations, while those on the west coast are of British descent of *recent* date

At the time of the conquest of Canada by the British in 1763 there were about 60 000 French in Canada These were almost all settled on the littoral of the St Lawrence, though many "Breeds," half French half Indian, were engaged in trapping around the Great Lakes The British held the far northern region under the Hudson's Bay Company, which has had a distinguished career from 1670 to the present day But this meant very little addition to the Canadian population Today people of French descent in Canada total nearly three millions (Fig 123) But this large group is almost wholly descended from the original French settlers, and there have been relatively few accessions since from France The large size of the families of the "habitants" is well known In Quebec (mostly French) the birth rate is 25.9 per thousand, while in British Columbia (mostly British) it is only 13.5 per thousand

¹⁴S. C. Ellis gives a graphic account of this canoe route with good sketches in an article in the *Canadian Geographical Journal* March 1936

The present habitat of the *habitant* is shown in the inset map in Fig 121 The French still cluster around the St Lawrence and a little to the south in New Brunswick They have sent colonies north

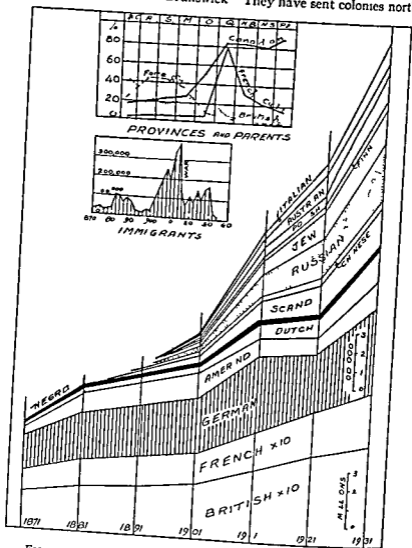


FIGURE 123—Cultural origins of the Canadian population scale reduced by ten for British and French. Inset: Variation of parents in the French culture (NB—The curve labelled Canadian includes those of

west into the Saguenay district and up the Ottawa Valley. Of late years they are spreading along the railways into the Clay Belt near Cochrane, and into the mining areas near Cobalt and Sudbury. Their critics say that they have a lower standard of living, their friends that they are more easily content, than the folk of British descent. No one denies their genuine love of the land, and unlike the British they prefer an environment with which they are familiar, to the hazard of moving far away in the hope of bettering their lot financially.

Professor Lower sums up the culture problems as regards Northern Ontario in the following words: "Between the French and English little real community of feeling or of action does or can exist. Scandinavians will quickly melt into Anglo Saxonism as they do everywhere, and the Germans will do so too, though rather more slowly. Even the Finns are said to learn English rapidly, and in general to adapt themselves to Canadian ways."¹⁵ He is not, however, very sanguine of any rapid amalgamation of the Poles and Ukrainians.

As regards the introduction of later culture groups, a graphic picture of conditions before and after the settling of the Prairie Provinces is given in Fig. 123. Before 1890 there was only a small population on the Prairies (see p. 332), and it was the building of the C.P.R. from 1881 to 1886 which settled these areas. Before that period the population of Canada consisted approximately of about two million folk of British descent (many arriving *via* the United States) and one million of French descent. There were, however, 250,000 of German descent, who far outnumbered the aboriginal population, and there were also a few thousand Dutch and Negroes. The Germans were grouped mainly near Lunenburg in Nova Scotia, and around Kitchener (once Berlin) and Walkerton in Ontario. Many of these were Mennonites from Pennsylvania, who had reached Ontario over a century ago.

Turning now to the west the Prairie Provinces offer a picture almost unique in world settlement. The United States in its days of *early* settlement had not such a polyglot mixture. Though, of course, today, just over the border from the Prairie Provinces, Americans face almost identical problems. Reference to Fig. 124 will show that Slavs (Ukrainians, Russians, and Poles) are in a large majority among foreign "cults." Germans and Scandinavians are abundant, while the French Canadian groups are much less significant.

¹⁵Lower and Innis, *Settlement and the Forest and Mining Frontiers* op. cit.

The French immigrants into the Prairies were largely brought in owing to the zeal of the French priests, who had long maintained missions to the Indians and the half breeds. Thus St Albert Mission was founded (near the Edmonton of today) as early as 1843. The fur trade and the buffalo were the main interests till the coming of the railway, and the priests greatly helped the trapping population during the difficult transition period before agriculture was firmly established.

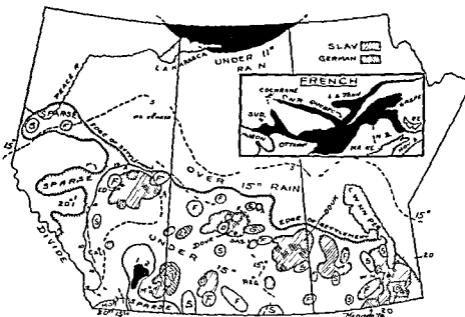


FIGURE 124—Foreign culture groups (cults) in the Prairie Provinces. Notice the abundance of Slav settlements on the northern margin. Dutch, Scandinavian and French are shown by initials. A indicates Austrian. Inset is a map of the French cult in Eastern Canada.

In 1875 before the C P R reached the province, German settlers arrived in Manitoba. In the summer of that year "a line of camp fires extending for miles and miles announced one evening to the lonely settlers of Pembina (Fig 119) that six thousand Mennonites had located on seventeen townships"¹⁴ These folk were Protestants who originated in the sixteenth century in Holland and Germany.

¹⁴J S Woodsworth *Strangers within Our Gates* (Toronto 1911)

They migrated in 1783 to the south of Russia and from there reached Canada in 1875

The tenets of the Mennonites may be gathered from the statement that they combine many of the views of the Baptists and the Quakers. Their first farms were arranged on the early European plan, each farmer having one village plot, a strip of good land, and a portion of hay land more remote from the village. Each village had its own "Colony Church," and elected its own "Headman." Today the general pattern of the Mennonite villages differs little from that of the adjacent Canadian towns. In 1882 the railway reached them, bringing settlers of various other "cults." A daughter colony was then established at Rostherne near Saskatoon (Fig 124), and in 1892 many left for Mexico. Winkler, Morden, and Gretna, all southwest of Winnipeg, are their chief centres in Manitoba.¹⁷

The Scandinavians and Russians, who constitute such a large proportion of the prairie population, have almost all arrived since 1900. Between 1906 and 1911 railways linked Edmonton, Saskatoon, Dauphin, and Winnipeg, i.e., along the northern frontier. As we have seen, this is the region of the best soil, and the rainfall is rather better than along the main line of the Canadian Pacific Railway.

The early immigration of the Slavs into the Prairies may now be briefly described. In 1801 the Czar allowed the *Doukhobors*, an unorthodox religious group, to settle near Azov in South Russia. They refused to obey the requirements regarding military service, and from 1826 to 1840 many migrated to Armenia. In 1899 over 7,000 came to Canada with the help of the Quakers on this continent.

Their chief settlements were in Saskatchewan near Saskatoon (Blaine Lake), and near Kamsack on the eastern border. (These localities are indicated by *Douk* in Fig 124.) As usual, the arrival of the railway (in 1903) brought in many rival settlers. Nowadays only about 30 per cent of the population is Doukhobor in their original districts around Verigin and Saskatoon, and they are much outnumbered by Slavs of the Greek Orthodox Church. In 1908 a daughter colony was formed in British Columbia in W. Kootenay. Here there are 6,000 Doukhobors of the more primitive type, while the 7,000 who remain in Saskatchewan are gradually acquiring more of the general Canadian culture.

The *Mormons* from Utah possess a belt of country about 50 miles

¹⁷An excellent account of these culture groups will be found in C. A. Dawson, *Group Settlement in Canada* (Toronto 1936)

by 75 miles on the southern border of Alberta (Fig 124) This is largely a grazing country but irrigation is an important feature also The Mormons settled near Cardston in 1887, and they cut the first irrigation canals in 1898 Many sugar beet factories around Raymond are in their hands Cardston is one of their 'Holy Cities' and possesses a striking Temple It is the centre of a group of about 13 000 Mormons

A brief description of Oriental immigrants will be found on page 354

F Traverse across the Prairies

The contrast between the Shield and the Prairies can be understood by comparing the two photographs (13 and 14) on Plate IV The somewhat infertile glacial debris on the Shield is covered with a thick forest of small trees, while the rich soil of the Prairies 100 miles west of Winnipeg originally carried hardly any trees The small clumps appearing in the background of the photograph have all been planted by the farmers as wind breaks and wood lots

Winnipeg is the fourth city of the Dominion with a population of about 250 000 It is a fine city of quite late origin hence it is more like the average American city than are the old centres of Montreal and Toronto

As one moves west over the grass lands (Fig 121) the landscape only slowly changes its character At Virden near the border of Saskatchewan the country is rolling with sluggish streams flowing in shallow gullies Often wheat is grown for a cash crop, and barley and oats to feed the dairy herds (Fig 119)

Broadview is a typical little prairie town of several hundred inhabitants about 100 miles east of Regina There is only one hotel which depends for water supply on the catchment from its tarred roof There are half a dozen stores and several *cafés* Two large elevators alongside the railway and many large oil tanks are the most prominent features in the landscape The creamery is out of use since the cream is now sent to a larger town in the vicinity From here to Regina the country is almost flat Many shallow depressions (sloughs) sometimes containing water dot the prairie In the summer acres of wild mustard colour the country a blinding yellow

At Swift Current it is interesting to see the steps taken by the better informed farmers to combat drought and soil-drift For miles there are no trees even around many of the farms in this semi arid

region In preparing the ground for grain, the soil is broken up and left in large clods, very different treatment from the old practice of covering the ground with the finest possible mulch Alternate rows about 60 feet wide are seeded or left in clods, which seems to prevent any large scale soil-drift High hedge rows of *Carra gâna* (a Siberian legume), mixed with small trees fringe the fields, and these also help to anchor the soil With an average rainfall of 13 15 inches and the low annual evaporation of these latitudes, the writer would judge, from his Australian experience, that returning good seasons will enable this country once more to become an important grain producer

Around Medicine Hat the presence of abundant low cactus clumps amid the tussock grass is evidence that we are in the heart of the grazing area ¹⁸ Medicine Hat is on the south bank of the Saskatchewan River, which here flows below bluffs two or three hundred feet high¹⁹ in a valley about half a mile wide Natural gas is abundant and is piped through the town and used in the municipal pumping station Some farmers are trying to grow barley and wheat with the natural rainfall, but I fear not successfully of late years Many acres of alfalfa are grown by the aid of irrigation in the river flats at the foot of the bluffs, below the main prairie levels (Fig 124)

Lethbridge has a somewhat similar situation on the east bank of the deep valley in which the Saint Mary River flows The enormous Cretaceous coal beds were first worked here The coal outcrops about river level, and horizontal drives are worked at many points near Lethbridge in a primitive fashion ²⁰ There are a number of larger mines near the town also

The most interesting spot is the large Experimental Farm about five miles east of the town Here water was brought from the upper Saint Mary, about 65 miles from the town, about 1906 Now dense poplars 40 feet high and lovely lawns and gardens flourish where was arid prairie thirty years ago There are about 150 000 acres irrigated near Lethbridge ²¹

The sudden rise of the Rockies from the Prairies is clearly visible in Photo 21 (Plate V), which was taken west of Calgary The western rim of the Prairies is better suited for settlement than the region round Medicine Hat, as is clear from the maps in Fig 121 On the

¹⁸In Plate IV, Photo 15 the hat is placed in such a clump of cactus

¹⁹See Plate IV, Photo 15

²⁰See Plate V, Photo 17

²¹Some of the ditches in the Government Farm are shown in Plate IV, Photo 16

way north from Lethbridge to Calgary we pass the Turner Valley, where valuable supplies of oil have been found. During the crustal folding which formed the Rockies, anticlines were formed in the underlying Cretaceous deposits. These "domes" have been an important factor in forming the reservoirs for the oil under the Turner Valley. Crude naphtha was struck in a well in 1914, and a heavy flow of wet gas was reached at 3,740 feet in 1924. Most of the oil is obtained as crude naphtha accompanying large flows of wet gas.²² Several new fields were discovered in 1916-7-8 in the vicinity of Edmonton. Of these Leduc is more promising than the early discovery at Turner Valley.

²²Fifth Pacific Science Congress Vancouver 1933 *Guide Book 3*

CHAPTER XXV

SETTLEMENT IN BRITISH COLUMBIA FUTURE CANADIAN POPULATION

A General Geological Conditions in British Columbia

The western province in the Dominion is much more complex in its structure than is any other province for reasons noted earlier. Here topography definitely controls climate, for the isotherms and isohyets agree with the contours and do not assume the east west directions which are usual in *level* lands. The reader will do well to refer to Chapter II to refresh his mind as to the mechanism of mountain building. Especially should the maps in Fig 5 be kept in view.

Following S J Schofield¹ the events leading to the present topography may be summarized somewhat as follows. During Triassic times (about 100 million years ago) most of Canada was a land surface, though an extension of the inland sea probably covered much of British Columbia. The western portion of the continent was buckled in Jurassic times. Large masses of grano diorite welled up from below (forming *batholiths* which did not reach the surface) which today form the cores of the Coast and Selkirk Ranges. In Cretaceous times these ranges were worn down to a peneplain. The immense Cretaceous deposits already referred to, gradually filled up much of a great geosyncline (earth trough), which had developed between the Cascadian 'Old land' (a vanished continent west of Vancouver) and the Laurentian Shield.

In the early Tertiary times (say 40 million years ago) British Columbia was remodelled by the Laramide folding, which was accompanied by outpourings of lava. An early stage of the folding appears at the top of Fig 125. The region east of the Selkirks was thrust violently to the east, so that ancient Devonian rocks were pushed right *over* the *younger* Cretaceous rocks, as we can see in the Crow's Nest region. This was the birth of the Rockies proper, and one of the major faults is indicated at the right in the lower sketch of Fig 125. Further outpouring of lava filled up much of the lower area between the Coast Range and the Selkirks. Meanwhile, the Cascadian 'Old

¹Fifth Pacific Science Congress, Vancouver, 1933 *Guide Book 3*

land" had sunk beneath the sea. It did not include Vancouver Island, which consists largely of the crumpled sediments originally laid down in the Cretaceous Sea. Later uplift in Pliocene times has raised British Columbia far higher, and led to the cutting of canyons and the removal of most of the lava-flows from the lower areas.

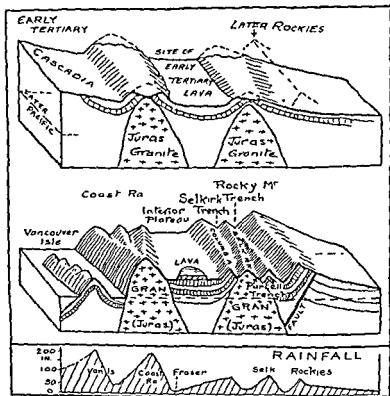


FIGURE 125—Two block diagrams showing in a generalized fashion the gradual evolution of the Young Mountains in British Columbia. (Based mainly on data by Schofield) Below is a graph showing the control of rainfall by structure

The topography of today can be readily understood from the lower sketch in Fig. 125. North-south folds characterize the whole region, but they are not all of the same type. The Selkirks and Coast Ranges are re-elevated ridges, first formed in Jurassic times. Their

evolution is something like that of the Appalachians (see p 18) Vancouver Island is a folded area which was mainly elevated after the Cascadian 'Old land' vanished in middle Tertiary times The Rockies proper originated in early Tertiary times as vast overthrusts and synclinal folds, but they have experienced several elevations The Interior Plateau exhibits relics of lava flows which once covered far greater areas In places, marine silts show that some of the lower valleys temporarily sank below the sea during Tertiary time

The traveller through the Rockies from Banff to Field crosses by the Kicking Horse Pass, discovered by the geologist Hector, at a height of 5,338 feet This is considerably higher than either Crow's Nest Pass (4,459 feet) to the south, or Yellowhead Pass (3,700 feet) to the north The "grain" of the mountains runs right across the

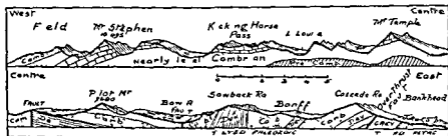


FIGURE 126—Geological profile-section across the Rockies from Field to Banff (35 miles) showing the three sets of formations separated by Major Faults (Based on *Transcontinental Geological Guide* 1913) (N B—The section from Mount Temple to Pilot Mount is omitted)

desired route of the railways and most of the valleys naturally follow the softer layers among the folded rocks This is shown in the geological profile given in Fig 126, where all the ridges run north and south But the enormous glaciers of the Ice Ages were 6 000 feet thick in places, as, for instance, in the Okanagan Valley² They helped to cut out the huge east west troughs, of which one of the most striking is illustrated in Photo 22 (Plate V) Notice in the geological profile (Fig 126) the different character of the layers in the west, centre, and east of the portion illustrated In the west and centre are the nearly level Cambrian rocks, in the east are steeply tilted Devonian and Carboniferous rocks (near Banff), and still further east are the much younger Cretaceous rocks, which have been tilted up by the pressure of the preceding rocks thrust from the west

²Pronounced Ohka nõggan

The geology of British Columbia is much too complex to be described in this brief sketch. It is worth noting however, that the western portion of the mountain system (i.e. west of the divide of the Selkirk Range) has been subjected to pronounced *volcanic* action many times in the geological record. On the other hand the Rocky Mountains and the Purcell Range have been free from such action. This has a considerable bearing on the distribution of mineral veins. All along the east coast is one of the grandest areas of granite on the continent forming the batholith referred to earlier. It extends northward for 1 000 miles and eastward in successive exposures for over 300 miles. As we have learnt these granites were formed in late Jurassic times and owing to this intense intrusive action originating in deeper parts of the crust we find that the mineral veins are of much younger date here than in most parts of the world. Thus the copper ores in Southern British Columbia³ are associated with Jurassic intrusive action the gold deposits are a little younger (Laramide) while silver lead and zinc occur even in Tertiary rocks.

The famous mines of the province are almost all on the margins of these once deep seated intrusives which we call batholiths. This clearly shows that their origin is linked up with the latter. Some of these famous mines are Treadwell in Alaska and Stewart and Anyox north of Prince Rupert. In the south where the granites cover much wider areas are found the Britannia Mine (north of Vancouver) Copper Mountain and Sullivan. The latter is one of the largest lead zinc deposits in the world and supplies Trail the largest smelting plant in Canada.⁴

B Topographic Control in British Columbia⁵

Special features of the eastern ranges are the three great fold troughs which are shown in the sketch (Fig 125 middle). The greatest of these extends from the Yukon south to Flathead Lake in Montana a distance of 990 miles and is called the *Rocky Mountain Trench*. As Daly writes it is not a valley in the ordinary sense. It is like a trench dug by soldiers in hilly country which is not cut to a uniform bottom grade but is man-deep whatever the slope.⁶

³See the long article on British Columbia by the author in *Geographical Review* New York July 1942

⁴For detailed accounts of mining in Yukon Kootenay and Northern Ontario see Lower and Inn's *Settlement and the Forest and Mining Frontiers of the West*

⁵R. A. Daly *Transcontinental Excursion* (Guide Book 8 Ottawa 1913)

It determines the course of many of the main rivers of British Columbia, such as the Upper Liard, Parsnip, Finlay, Upper Fraser, Canoe, Upper Columbia, and Upper Kootenay Rivers. At Canal Flats where the Columbia rises, the Kootenay is only a few miles away at the same elevation (2 653 feet). Here a canal has been cut, so that the Selkirks are entirely isolated by navigable rivers. A second trough (about 220 miles long) carries the Beaver, Duncan, and Kootenay Rivers. It is known as the *Purcell Trench*, and as it is lower in the centre it contains Kootenay Lake. Somewhat similar is the *Selkirk Valley*, which contains another fiord like lake 92 miles long, called Arrow Lake.

Since these great folds and trenches cut right across the province, it is clear that the topography is particularly difficult in this region. Moreover, the deep valleys are shut off from the moist westerly winds, which tend to become warmer and drier as they sink into the valleys. The relation of rainfall to structure is clearly shown in the lower graph in Fig 125, and along the valleys the rainfall is often below 10 inches. On the other hand, the deposition of great thicknesses of lake silt and glacial debris in these valleys has made it rather simple to develop prosperous farms by means of *irrigation* from the numerous rivers.

The relation between structure and communications in Southern British Columbia is suggested in Fig 127. It was relatively easy in the early days to travel in a north-south direction along the numerous trenches, rivers, and lakes already referred to. But the main interests in trade necessitate traffic in east-west directions, and even today there is no satisfactory road of this type in British Columbia. There are two railway lines in the south of the province. The main C.P.R. runs fairly directly from Calgary to Ashcroft (*Ash* in Fig 127), and then turns south down the great canyons. But no road yet crosses the Selkirks west of Golden. Nor does the road yet reach the Big Bend of the Columbia, though it is being made northward from Golden and from Revelstoke. (It was completed in 1942.) From Revelstoke a good road now parallels the railroad to Vancouver.

The second route, the "Queen's Highway," runs close to the Boundary and is worthy of close attention (Fig 127). From Lethbridge the road runs west to the Crow's Nest Pass. Thereafter it zigzags in a fashion hard to parallel in any other region. It turns south to Waldo on the Kootenay River, and then proceeds north up the Kootenay to Cranbrook. Then it turns south and crosses the

Selkirks almost on the Boundary (at Yahk). It climbs to the north-west and Creston is reached. From here the road runs far north half-way along Lake Kootenay, where a ferry enables one to reach Nelson. From here we follow the Kootenay and Columbia south to Trail. A series of switchbacks, just far enough north of the Boundary to keep wholly in the Dominion, brings us after 150 miles to the Okanagan Valley. It is now necessary to ride almost north for 174 miles (via



FIGURE 127—A block-diagram of Southern British Columbia and adjacent parts of the United States. Lakes are black. Note that the "grain" of the country runs approximately north-south.

Princeton) to Spence's Bridge, near Lytton, on the Thompson. Then we turn south for 95 miles to reach Hope (which is only 40 miles due west of Princeton). A road is now being cut over Allison Pass which will obviate this enormous detour. The Crow's Nest Railway was finally completed later than the road, for the section north of Creston along Lake Kootenay (formerly traversed by steamer) has only recently been opened. It cuts across the mountains west of Princeton by a shorter route than that followed by the road. However, apart from

the short break along Lake Kootenay, the line from Crow's Nest to Vancouver has been running since 1915⁶

A glance at Fig 127 will show that the topography becomes much easier south of the International Boundary. The eastern part of Washington has been flooded with one of the greatest sheets of lava in the world. The Columbia River flows round the north end west of this great level sheet, which is about 1 500 feet above sea level. Better roads and better grades south of the border lead many travellers from the Crow's Nest area to journey to Vancouver by way of Spokane and Seattle rather than tackle the zigzags and detours outlined above which handicap the Queen's Highway.⁷

As regards settlement, British Columbia is the sole Canadian Province which resembles the typical Australian State. It is hardly an exaggeration to say that almost all the population is urban or suburban.¹ Out of a total population of 700,000 about 500,000 live within 50 miles of Vancouver or Victoria. The remaining 200,000 are scattered along the valleys of the southern half of the Province, while the northern half (180,000 square miles) is empty. A survey of the population map shows the vast importance of structure. The magnificent site of Vancouver as Canada's western port of entry, and the advantages of the delta and plain of the lower Fraser, are clearly geographical factors controlling the density of population (Fig 128).

C The Settlement of British Columbia

For obvious reasons the settlement of British Columbia was almost independent of that in the Eastern Provinces. Mackenzie reached Bella Coola Inlet on the Pacific from the Peace River in 1793, and in 1807 Fraser explored the river which bears his name. Thompson established Kootenay House in 1807 for the North West Company. Later it was transferred to the Hudson's Bay Company, which ruled the region for half a century. However, Americans were the first settlers in the southern part, and for this reason the portion south of 49° was allotted to the United States in 1846. Victoria was settled in 1843, and coal was discovered in the vicinity a few years later.

On the mainland there were only trading posts till 1857, when gold was discovered in the lower Fraser Valley. In 1858 over 30,000

⁶Harold Innis *A History of the Canadian Pacific Railway* (Toronto 1923)

⁷Stephen B Jones Cordillera Section of the Canadian United States Border land (*Geographical Journal* May 1937)

miners poured into the country, and they found gold from Yale northward to Lytton. A few years later the Cariboo country, still further to the north was found to contain rich gold. In 1858 British Columbia was made into a separate colony, which was reached *overland* via St. Paul in Minnesota. However, most of the early settlers travelled *via* Panama. In 1868 mining had declined and there were only about 8 000 white settlers in the colony.⁸

However for several decades mining remained the chief interest in the West, for soon the Kootenay district was found to be rich in many minerals. Ainsworth in 1883 Toad Mountain in 1886 Ross land in 1894, and later the great Sullivan mine at Kimberley, drew many folk to the province. The C.P.R. was completed at Craigellachie (near Lake Shuswap) in 1885. The Crow's Nest Railway after 1898 carried coal from the Cretaceous beds in the upfolded Rockies (Fig. 126) to the great smelters at Trail. In 1904 Kootenay was the chief market for the grain and meat of Alberta.⁹ From 1896 to 1911 was the zenith of the Yukon Gold Rush which naturally greatly affected economic conditions in the south.

The great fishing industry also waited on the completion of the railway to the east and its value rose from seven million dollars in 1901 to fourteen millions in 1913. Agriculture lagged far behind, even with the large mining population requiring food. "In 1891 the Province was importing large quantities of live stock, pork flour, etc., and exporting none."¹⁰

A brief discussion of the Orientals in the province is in order if only because considerable friction developed with the Japanese in 1907. There are only 42 000 Chinese and 12 000 Japanese in the whole Dominion so that proportionally they are insignificant compared with the Canadians. As elsewhere many Chinese migrated to the early gold diggings, and a number helped to build the Canadian Pacific Railway. In the period 1905 to 1910 no less than 13 000 Japanese and 11 000 Chinese entered the Dominion mostly at Vancouver.¹¹ But a Gentleman's Agreement with Japan, and heavy restrictions on the Chinese have stopped this influx. The Orientals are chiefly engaged in gardening, in laundries and especially in the fishing and canning industries.

⁸W. L. Grant *History of Canada* (Toronto 1922)

⁹See the excellent discussion in Mary Q. Innis *Economic History of Canada* (Toronto 1935)

¹⁰*Ibid*

¹¹J. S. Woodsworth *Strangers within Our Gates* op cit

D Timber and Agriculture in British Columbia

In the southern mountains all below the level of 3,500 feet was clothed in forests, and near the coast Engelmann's spruce is still the chief tree. Hemlock and western birch are common, while red cedar is found on the wetter slopes. The drier portion of the province, the so called "Interior plateau," has two kinds of forest. On the lower slopes near the large areas of grass land, is the yellow pine. Higher up, Douglas fir and aspen are more abundant. Proceeding eastward, as the higher portions of the Selkirks and Rockies are reached, Engelmann's spruce again forms the bulk of the forest cover. Lodge-pole pine and Alpine fir are common at higher elevations¹² (Fig 125)

Along the west coast are probably the best supplies of lumber left in North America. The Douglas fir (called Oregon pine in the United States) is the most valuable, but the red cedar is famed for roof-shingles, which are exported all over North America. The Sitka spruce, which grows to its largest in the Queen Charlotte Islands, and the hemlock are not yet in such demand.

A characteristic of the province, due, of course, to its rugged topography, is the relative isolation of the various agricultural districts. They are naturally found on the narrow coastal plains or on the flat floors of the north-south valleys. On Vancouver Island the best farms are on the drier eastern coast near Duncan and Courtenay.

On the mainland the largest river, the Fraser, has been pouring its silt into the Pacific for millions of years, and has produced a large delta of about 900 square miles. Dairying, orchards and grain are all important interests in this fertile region. Owing to its key position and abundant power resources, Vancouver is becoming an important manufacturing centre.

Among the many rather isolated farming districts (Fig 127), the Okanagan and Kootenay are perhaps the most important. The floors of these valleys are buried deep in silts, as explained in connexion with Fig 12. The rivers and lakes of today are often at much lower levels than when these silts were laid down, and these "benches" of fresh soil are easy to irrigate.

At Vernon, Kelowna, and Penticton there are many factories engaged in canning various fruits such as peaches, apples, almonds, and grapes, while tomatoes and onions are also grown largely. In the

¹²Halliday, *A Forest Classification for Canada*, *op cit*.

Kootenay Valley agriculture is of much the same type, while the dry slopes are suited for the grazing of stock. But here the most interesting feature is the large traffic in lead and zinc ore, which is carried from the Sullivan mine westward to be smelted at Trail. Here also is one of the largest fertilizer plants in America, where the acids produced as a by product are used to make phosphate and ammonia fertilizers.

E *Traverse of British Columbia*

In the last section of the traverse of the Dominion the Rockies were briefly referred to. The traveller proceeding westward crosses the steeply tilted Cretaceous rocks at Bankhead (Fig 126) where there are several coal mines. A mile or two to the west, the rocks suddenly change to the far older Devonian, which have been thrust bodily over the Cretaceous during the process of mountain building. We follow the broad Bow River Valley to Banff, where the Spray River enters from the south. It has cut its bed *along* a softer bed of the north south folds. The Bow River, however, has eroded its course right across a number of the folds from Bankhead to Sawback. Thence its valley turns and also runs parallel to the folds as far as Lake Louise, which is close to the summit at Kicking Horse Pass. This famous locality was first reached by the railway on December 6, 1883. The characteristic pyramidal mountains are due to the structure of the Cambrian rocks. The beds are nearly level, which makes them take on symmetrical shapes on erosion.

Lake Louise is a charming centre from which to study glacial action. Only a mile or two west of the C P R hotel are beautiful cirque valleys (Fig 126) containing small glaciers, such as Victoria and Lefroy. In parallel cirque valleys to the south are the Horse-shoe and Wenkchemma Glaciers. They are of the type sketched in Fig 12 at *D* while the Bow Valley was cut out by a glacier of the type shown at *C* in Fig 12.

Space is lacking for further reference to the attractions of the Rockies for tourists. Stephen B Jones has given a thoughtful analysis of the way in which environment controls Tourism.¹² He groups the resorts in three classes, as follows 'Headquarter Resorts,' such as Banff which may not have any remarkable feature close at hand, but offer many pleasant excursions within easy car ride. Hence such

¹² Recreational Regions of the Canadian Rocky Mountains (Bulletin of the Geographical Society of Philadelphia July 1936)

places usually attract tourists for lengthy visits. In "Objective Resorts," such as Lake Louise, there may be only a few points of great interest close at hand, and they are more quickly exhausted. Hence the tourist's stay is shorter. "Wayside Resorts" exist primarily to supply passing tourists. The 'Objective Resorts' are nearly all in the higher central part of the Rockies, while the 'Headquarters' are on the margins where communications are easier.

A few miles west of the Kicking Horse Pass the railway rapidly descends nearly 100 feet to the river, by means of two spiral tunnels cut in the sides of the valley above Field. So far the glacier cut valley is broad and relatively easy to negotiate. But near Leancoil the river has deviated from its old course, owing to morainic dams, and has cut a narrow canyon from Palliser to Golden (Fig. 127).

Golden is a quiet town of 400 people where the railway reaches the Columbia River. Formerly a mining and lumber centre, it has decayed since the local timber has been cut out. We are now in the "Rocky Mountain Trench," and we can branch off and follow it south to Lake Windermere and to the remarkable low level divide between the Columbia and the Kootenay Rivers.¹⁴ The two rivers have here been connected by a short canal as noted earlier.

From Golden to Beavermouth the railway runs north along the wide "Trench" (p. 350). It then turns west once more to cross the Selkirk Mountains. These are somewhat lower than the Rockies, but they have a heavier rainfall (Fig. 125), and consequently possess finer forests and glaciers. To escape numerous curves and snow sheds, the railway now reaches Glacier by the Connaught Tunnel, which is five miles long and almost the biggest work of its kind in America.

The traveller will do well to alight here and visit the lovely Asulkan Valley, leading to the Illicillewaet and Asulkan Glaciers. The former is a sheet of ice covering about ten square miles, just to the south of the impressive pyramid of Mount Sir Donald (10 818 feet). The railway now drops 2 000 feet down the Illicillewaet Valley to meet the Columbia River again at Revelstoke (Fig. 127).

At Sicamous we skirt Lake Shuswap, one of the numerous glacier-formed lakes, and then follow the South Thompson River to Kamloops. Here we are in one of the regions of least rainfall in North America. Owing to the dry climate, the little city has several famous institutions for treating tuberculosis. A tramp down the valley to the Tranquille

¹⁴This by-pass bifurcation of the Kootenay River is sketched in the writer's memoir on British Columbia (*Geographical Review* July 1942).

Sanitarium will give us some idea of a tiny ' Rain Shadow Desert Cactus and sage brush cover the slopes of the wide valley, and in the vicinity are large sheep and cattle ranches. The cactus usually occurs as patches of small spheres each an inch or two in diameter. The rattlesnake a member of the desert fauna reaches as far north as Kamloops and Ashcroft. Soon the river widens to make a small lake which is held back by glacial debris at Savona¹⁵. After the spring thaws the lake rises several feet and later, after it falls fine crops of hay are cut from the lake flats. The surrounding hills are formed of Tertiary lava which weathers into strange pinnacles. Considerable areas are irrigated by water brought from eight miles to the north producing valuable crops of tomatoes, potatoes, and melons.

The next section of the journey offers one of the finest series of canyon views in the world. At Ashcroft we can see terrace above terrace cut by the river in the silts of a bygone lake¹⁶. All this part of the province has experienced several elevations in Tertiary times so that complicated cross sections of the valleys are to be expected (Fig 127). The Black Canyon is incised 200 feet in the Cretaceous rocks just below Ashcroft and just above Lytton is another narrow gorge. We now reach the Fraser Canyon along which the Royal Engineers together with many miners and Chinese labourers cut the famous Cariboo Trail in 1862-5.

From North Bend to Yale, the river is hemmed in between the Coast Range and the Cascade Range. Its valley has been partly eroded by glacier ice but is narrow in the hard granite and wider where it flows in softer rocks. Near Hope the Fraser takes advantage of shear-cracks in the granite to cut out its narrow gorge. Below this town it turns to the west and flows placidly in a broad valley to its delta in the Pacific some eight miles south of Vancouver.

The railway in 1886 ended at Port Moody at the head of Burrard Inlet. But the beautifully situated city of Vancouver has grown up eight miles nearer the ocean on the south shore of the inlet facing the Lion Mountains. Fifty years ago it was a forest clearing now it is a city of 271 000 people. Owing to its terminal position on two vast transcontinental railways it has an immense trade with the Orient. Perhaps the chief trend of late in its commerce has been the great increase in the wheat-export from the western Prairies. This in turn is largely due to the shortening of the sea route by the Panama Canal.

¹⁵See Plate V Photo 24

¹⁶See Plate V Photo 23

F Settlement in the North West Territories

Before discussing the possibilities of future settlement in Canada, a brief description must be given of the empty lands to the north of the areas already described in this survey. The account given by Dr Isaiah Bowman in his book *The Pioneer Fringe*¹⁷ can hardly be improved upon and the following paragraphs are based on it.

The best actual example of pioneering on a fairly large scale is the Peace River Settlement, about 250 miles north west of Edmonton. Here some 73 000 square miles of good farming land are to be found north of latitude 55°, which is much the same position as the extreme north of Scotland. There were only 2,000 people in this district in 1911, even if we count Indians and half breeds. In 1931 there were over 60 000 new settlers. The railway reached the district in 1916 but now that there are fair roads motor trucks haul goods to the railway from farms fifty miles from the latter. Fifty dollars an acre is not an unusual price for an acre of new land but most of the better-class land has now been occupied. Much of the remainder needs heavy clearing of the poplar and willows which cover it.

Spring wheat is the principal crop, and even the cooler uplands can be used by growing quickly maturing varieties of wheat. Oats and barley are also grown, and cattle and hogs make the farmer slightly less dependent on the vagaries of the weather. Winter feeding of livestock is necessary, about 3 tons per head being the general rule. There is also usually a market for the white spruce, which the farmer can cut in the vicinity of his farm.

Passing still farther to the north down the Mackenzie Valley, we reach the region of the North West Territories. This is an area of 1 300 000 square miles with a total white population of about 1,000, together with 7,000 Eskimos and 4 000 Indians. Here also agriculture on a limited scale is possible. Along the Slave River, cereals, hay, potatoes, and vegetables have all been grown for many years in the gardens adjoining the trading posts and missions. In all cases, risks of frost and also of drought have to be met, for this is a region of very low precipitation (Fig 108). At Good Hope, within twenty miles of the Arctic Circle, new potatoes of good size were dug as early as July 12 in 1921. At Aklavik (lat 68°N) several acres of oats have been grown for the local cows. At these northern stations fair to heavy yields of wild and domestic grasses of several species can be depended

¹⁷New York 1931. See also my long account in *New Northwest* (1947)

on every year; and even if oats do not mature, they can usually be counted on as green feed for cattle. All common vegetables, and occasionally tomatoes and cucumbers, have been raised in the Mackenzie Valley.

Beyond the grain-fields come the pastures. This statement is as true on the "Cold Desert" edge as it is on the "Hot Desert" edge. There will undoubtedly be a considerable expansion in the raising of reindeer in the future. It has been estimated that the littoral, from Aklavik for a thousand miles to the east, may be able to graze 250,000 head of cariboo. This, of course, would add little to the human occupancy of the district.

Lack of space prevents any discussion of the large islands known as the Arctic Archipelago, which are included in the North-West Territories. Their small value under present-day circumstances can be gathered from the following table of their very meagre populations¹¹

	<i>Whites</i>	<i>Eskimos</i>
Baffin Island,	49	1,597
Ellesmere Island	2	8
Melville Peninsula	4	234
Southampton Island	7	143
Somerset Island		24
Devon Island	3	8
Hudson Bay Isles	10	422

G. A Tentative Forecast of Future Canadian Settlement

From a consideration of the climatic controls and of the reasons underlying the distribution of present-day population, it is possible to make some estimate of settlement in the future.

We can profitably compare the spread of settlement in the Northern United States with that which has taken place across the International Boundary. The latter, for a considerable distance, is a mere astronomical line (i.e., Latitude 49°). Although the divide between the Missouri waters and those flowing north was one of the factors in deciding the Boundary, this divide is very little in evidence. One eminent geographer confesses that he had to look at the names over the Banks to know if he was on the American or the Canadian side of the Boundary!

The fringe-like character of the Canadian population is well brought out in Fig 128. Only near Montreal and Toronto is there any

¹¹*Canada's Eastern Arctic* (Ottawa, Department of the Interior, 1935)

dense population, i e., over 45 to the square mile. Contrast this with the immense black area in the eastern American states. The warmer climate, heavier rain, better soils, and, above all, the great coal supplies to the south, have led to this striking difference.

Only about longitude 112° (running near Edmonton) does Canada have the advantage. Here is the strongest population "link" between the west and east coasts of North America. In the United States the desert separates the two areas, and in *Northern* Canada the tundra. But the rich soils (of Alberta), which fringe the north edge of the semi-desert and desert (for reasons explained on page 333), belong to Canada and not to the United States.

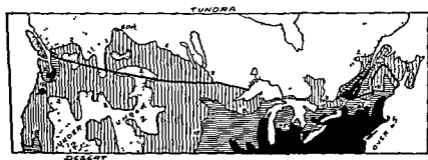


FIGURE 128.—Relation of the population density in Canada to that in the United States. Uniform rainfall and coal are the chief factors in the Eastern United States. The Shield and cold are adverse factors in Canada. Isopeleths somewhat simplified. (From J. Goode.)

The map also shows how definite is the population break along the north shore of Lake Superior; though it is difficult to understand why *four* lines of railway (through Cochrane, Oba, Woman River, and Regent) are needed to carry the traffic across this empty piece of the Shield!

From the discussion in Chapter XXII, it will have been gathered that most of Canada has a satisfactory average annual rainfall. One notable exception is found in Southern Alberta (Fig. 129). Here is a small region which receives less than 11 inches of rain. It is clearly a "Rain-Shadow" area in the lee of the Rocky Mountains, which cause the descending west winds to become adiabatically heated and dry. There are also sheltered dry valleys in British Columbia, but there the presence of numerous rivers makes irrigation a simple matter, as we have seen.

Turning now to temperature control and confining our attention

to summer temperatures, we have already noticed that the isotherms do not run west east as we should expect in the level region of Central and Eastern Canada. The enormous ice cap of Greenland, and the cold Arctic currents flowing down each side of it, distort the summer isotherms, much as if the Pole were in the centre of Greenland. Possibly if Greenland were to vanish, it would not help much. For

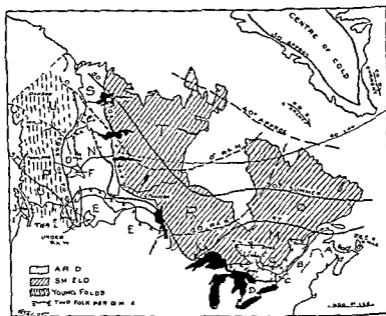


FIGURE 129—An analysis of Canadian population present and potential in terms of Geographic Controls. Areas A to K already have over two people per square mile. Some of the larger metal mines are shown.

though north-east Canada would thereby become much warmer in summer, the sterile character of the Shield would prevent close settlement. Luckily the best areas of deep soil (associated with younger "mantles") are found far to the west where the Greenland control is least effective.

Long ago scientists such as Stupart and Unstead suggested the temperature control which would be found to control the northern extension of agriculture. The bitter cold of the winter is not very material, but it is found that the isotherm of 57° F for the months of June, July, and August gives a fairly reliable criterion as to future

practical crop lands (It is curious how closely this isotherm follows the edge of the sterile Shield, to which it has no obvious relation) There are not enough weather stations to plot it accurately north of Athabasca, so that different authorities give slightly different positions This is perhaps the most important *isopleth* (line of equal distribution) in the Canadian environment and it is indicated by the figure 57 along the heavy line in Fig 129

We have now discussed two limits to settlement in Canada The first is the Precambrian Shield and the second the 57° F summer isotherm A third is the eastern edge of the huge mountain area which was turned into a jumble of folded ridges during Tertiary times This line also is shown in Fig 129 as 'Edge of Folds' There are of course, many fertile valleys among these folds, but not areas of level prairie or level rocks, such as are characteristic of the Prairie Provinces and Southern Ontario Excluding these less attractive areas, there are left the Maritimes *A*, Southern Quebec *B* and *C*, Southern Ontario *D*, and the areas labelled *E*, *F*, *N*, and *O* in Fig 129 All these are capable of closer settlement while *N* and *O* have hardly been exploited at all at this date There are also many other areas which have claims to our consideration, and these have been labelled in the map and are classified in the table on page 364

The essential features of settlement are briefly analysed in the same table When a Dominion has been undergoing settlement for as long as 300 years, the present day population is the best clue to future population In Fig 129 the boundary of important settlement is shown by the isopleth of two per square mile (labelled 2) In the table all the regions with this density are given in Class I In the second class (II) are regions still empty but with a fairly reasonable summer They will certainly fill up next In Class III conditions are not very attractive, but important settlement will undoubtedly be possible in restricted areas In Class IV, apart from Mining, there is little chance of settlement. However, the presence of water, power, and lumber gives this empty area far greater possibilities than in the *huge empty lands in Australia, where there is no water, and therefore no water power, agriculture fuel, or lumber*¹

The very great assets and possibilities of regions *A*, *B*, *C*, and *D* are fairly well known The considerable density of *G* is rather surprising since it is on the sterile Shield But small farms, water-power, lumber, and pulp account for many of the inhabitants, while the metal

SETTLEMENT AREAS IN CANADA

	<i>Paleozoic rocks</i>	<i>Prairies</i>	<i>Folds</i>	<i>Shield</i>
Main products	Farms some mines	Farms Coal	Fruit Mines	Metals Lumber
Class I Over 2 per square mile South of 57° F	A Maritimes B Southern Quebec C Southern Ottawa D Southern Ontario	E Saskatche- wan Basin F Mid Peace River	H Okanagan and Kootenay J Southern Vancouver	G Sudbury Saguenay K Fort William
Class II Potential settlement South of 57° F		N Athabasca Liard	L Upper Fraser to coast	M Clay Belt and vicinity
Class III Transition		O Fort Nelson	P Skeena	
Class IV No notable settlement ex- cept mines likely	Northern archipelago	S Lower Mackenzie	U Yukon	Q Northern Quebec R Patricia T Keewatin

mines north of Sudbury have led to the growth of quite large towns. This is indicated in the following table based on the 1935 populations

Sudbury	19 600
Timmins (Porcupine Field)	17 000
Cobalt etc.	9 600
Kirkland Lake	9 900
Noranda	4 000
Amos	3 000

The important population in the area *K* is mainly due to the shipping facilities at Fort William and Port Arthur, etc., together with many small mines in the vicinity. Such *entrepôts* are not likely to develop elsewhere on the Great Lakes. At *F* is the very interesting settlement at Peace River, where wheat and other crops are grown successfully, even though it seems to be actually on the critical

summer isotherm of 57° F This region is a good omen for extensions to Athabasca Valley and even north to the Fort Nelson and Liard Valleys (O) in the cooler west Of course, the variability of the weather as regards rain and frost must considerably affect future settlement But these cannot be discussed here, though they are treated in an excellent fashion in Mackintosh's *Prairie Settlement*¹⁹

The character of the climate changes so completely as we cross the Rockies that controls of settlement in British Columbia are rather different from those in the rest of Canada The climate is much moister and less extreme, so that fruit and dairies rather than grain will be the main agricultural resources However, the population will undoubtedly spread northward considerably, but it will be long before the population isopleth 2 passes north of the isotherm 57° F

Let us look at the problem from a wider point of view Canada seems to offer a good field to test the validity of the "Possibilism" theories of certain geographers They believe that man is not controlled by his environment, but that he himself decides which of possible methods of exploitation of Nature he shall pursue The writer uses the term "Weocratic" to express this idea that man can choose *his own* path in life, and the term "Geocratic" to indicate the philosophy of Humboldt and Ratzel (Control by Environment), to which he himself adheres²⁰ In a region of such immense resources as the United States, it is easy to see how the 'Weocratic' school of geographers could arise But a student of hot, arid Australia or of cold, sterile Canada is likely to be a little more doubtful if man really has much control over Nature He tends to belong to the "Geocratic" school (see p 469)

The stage-diagram forming Fig 130 may help to explain how this idea of "choice of possibilities" has arisen It is true that in Southern Ontario we have seen man at first dependent chiefly on fur, then on lumber, then on farming, hydro electric power, and mining But all these in turn depend on Nature's bounty, and, given sufficient knowledge, could be predicted as the inevitable development of an expanding nation in the given environment

In the lowest stage in Fig 130 we see a generalized economic map about 1750, showing that fish, farms, and fur had expanded to the

¹⁹Op cit

²⁰The teleological school of Ritter and others may be termed the 'Theocratic' group See the writer's recent paper *Geography the Correlative Science* (*Canadian Journal of Economics and Political Science* Nov, 1935)

limits approximately there shown²¹ Some sixty years later, by 1810, farming had spread approximately to Detroit, while Mackenzie was exploiting for furs the river basin named after him By 1870 mining was becoming of some importance, and gold (Au), silver (Ag), and iron (Fe) mines were being exploited both near the St. Lawrence and

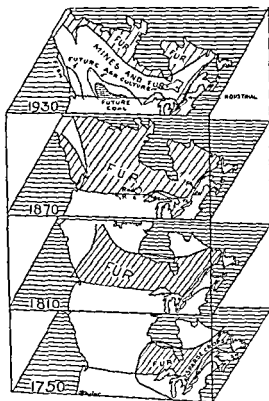


FIGURE 130—A stage-diagram showing in a generalized fashion the spread of economic zones from 1750 to 1930

on the Fraser River. Still more important, Selkirk had sixty years earlier settled his isolated band of farmers on the silts of Lake Agassiz in the heart of the continent About 1880 the modern migrations to the wheat-fields of the Prairies began In the last and uppermost stage we see in a generalized fashion the conditions today. The

²¹The dates given are from Mary Q Innis, *Economic History of Canada*, *op cit*

whole Dominion is being exploited not only for furs but for metal mines the latter in part by air transport Agriculture has covered most of the inland Prairies, and will extend north (and into the Clay Belt) as indicated by the crosses Manufactures have spread along the St Lawrence from Montreal to Ottawa and Windsor, in large part owing to the bountiful water power

But while there have been these striking advances and changes in the type of industry, man has not really been a free agent His advance from fur hunting to wheat growing is only possible where rain and sun and soil are satisfactory All the fur country cannot be utilized for wheat, even if man so wishes Using a foreign example, we shall never see hydro electric power or coalfields leading to the development of factories in that half of the southern continent known as 'Empty Australia,' however much man may wish to replace the sparsest of pastoral occupation by better paying industries On the other hand, it seems clear to the writer that in the future the immense coal resources of Alberta must inevitably be utilized, as the more accessible coalfields are used up elsewhere Man may very probably some day 'choose (as the 'We ocratic' School would say) to give up ranching in the drier parts of Alberta, and turn to manufacturing based on the almost inexhaustible coal But he is none the less controlled by his environment

When one tries to forecast the future population of the Dominion, so many difficulties arise that it is obvious that no accurate answer is possible There are folk who say that ten millions is the best figure, since today we have some difficulty in supporting thousands of unemployed Others point out that the natural increase of the population about 130 000 per annum is not far removed from the number of new positions which become available each year This group usually advocates the cessation of all immigration But supporters of such views cannot have studied much history or geography

Every young nation has passed through many periods of unemployment and allied difficulties, yet in time its population has greatly increased, and Canada will be no exception The geographer can at least make some attempt to classify and grade the lands available for the present and future populations He realizes that pioneers need more land for a living than do the farmers of older lands, but this pioneer condition will not hold indefinitely For instance, in the Prairies a farmer needs about 400 acres (Fig 121) If now we turn to Silesia (in the south-east of Germany), where the environment is

somewhat similar, we find that farms run to about 50 or 60 acres²¹ In North China, also with a cool continental climate, the farms are much smaller, possibly about one-tenth of this area. Cressey gives the figure of 0.43 acres *per person* in agricultural China²² Hence, when we make a forecast, we must state what kind of a culture-pattern we have in mind. Is it to be pioneer as in Manitoba, or a higher standard as in Iowa, or a mere subsistence farm as in parts of Europe, or the absolute minimum for human existence as in much of China?

The following table is taken from the official *Canada Year Book*, 1934-5. It shows that the agricultural lands occupied are about 163 million acres. Of lands still available as farms, etc., and not, of course, of such high utility as the former class, there are said to be 198 million acres. A first approximation would tell us that we can support about as many more settlers (i.e., another ten millions) without extreme difficulty. This is assuming, as we may fairly do, that technological improvements will balance the poorer quality of the land. So far we are making no allowance for altered standards of living.

AREAS OF OCCUPIED AND POTENTIAL AGRICULTURAL LANDS
Areas in thousand acres

	<i>Area occupied</i>	<i>Still available</i>	<i>Total for agriculture</i>	<i>Total land</i>
Prince Edward Island	1,191	66	1,258	1,398
Nova Scotia	4,302	3,790	8,092	13,275
New Brunswick	4,152	6,566	10,718	17,734
Quebec	17,304	26,441	43,745	335,062
Ontario	22,841	42,996	65,837	232,500
Manitoba	15,132	17,248	32,380	140,623
Saskatchewan	55,673	24,400	80,074	152,304
Alberta	38,977	48,473	87,450	159,232
British Columbia	3,542	19,061	22,603	229,939
Total (including N.W.T.)	163,119	198,043	361,162	2,218,747

We can, however, attack the problem in another way. Geographers are agreed that the population density of Europe is almost wholly controlled by crops and coal. Granting this, in Fig. 131 the

²¹ Bowman, *The New World* (New York, 1928), Fig. 84

²² 'Agricultural Regions of Asia' (*Economic Geography*, Worcester, April, 1934)

writer has attempted to answer the following question How many people can Canada support, *using the same standards* as those of Northern Europe, including the use of coal to the same extent?



FIGURE 131 — Regions of present and future fairly close settlement in Canada (as determined solely by climate and crops) shown by the dotted areas The huge area of Cretaceous coal is shown in black Below, to the same scale, are six European countries with their populations (in millions)

POPULATIONS OF SOME EUROPEAN COUNTRIES

European country	European population	Canadian parallel
South Norway	3 millions	South British Columbia
Germany and Poland with 450 000 million tons of coal	92 millions	Prarie Provinces with 46 000 million tons of coal
South Finland	3 millions	Clay Belt
Czecho-Slovakia, very rugged in east	14 millions	Southern Ontario and Quebec
South Sweden	6 millions	Maritimes
TOTAL POPULATION	118 millions	

As we have seen in the earlier sections, the climates of Northern and Eastern Europe are not unlike those of Canada. This first approximation consists therefore, merely in comparing approximately equal areas of Canadian and European lands, and noting the populations maintained in the latter areas. (In the three Scandinavian countries all but a negligible proportion is contained in the southern thirds.) These data are also contained in the preceding table.

We may not want so many people. We cannot at present utilize the Alberta coal. Many other factors, such as transport, mechanization of farms, exchange of commodities, birth control, standards of living etc. have not been considered. But it is difficult to deny that Canada's assets (and remember we have ignored all but the southern part of the Dominion shown dotted in Fig 131) are approximately equivalent to those of the six European countries specified, which today maintain a population of over 100 millions.²⁴

In various recent publications the writer has been attempting to contrast the possibilities of "Empty Canada" with those of the very similar regions in Siberia. In his pamphlet *Canada's Role in Geopolitics*²⁵ he shows that the area with possibilities for growing potatoes, oats, hay, etc., in Canada is about half that of the similar possible (not very attractive) farm land in Siberia. In the latter country the Soviet authorities claim that they are going to settle much of their future population, which may reach 340 millions by 1975. In Canada some folk appear to think that our present population of eleven millions is an optimum. It is obvious that this northern "potato-zone" is only third or fourth class land, and that it will cost immense sums to drain it properly. Yet official maps show that root-crops can be grown throughout the pine forest (Taiga) country,²⁶ almost up to the edge of the tundra (Fig 87). At present, costs of transport swallow all the profits in such farming, but in Canada, as in all other pioneer lands today, progress is slow, and depends in large part on the gradual approach of denser populations based on mines, or on better-endowed farm lands or on industrial occupations.

It is the special duty and privilege of the geographical workers in Canada to see that the future millions of Canada are settled where Nature has furnished the best environment for them.

²⁴This last section is based on the writer's paper *Fundamental Factors in Canadian Geography* (*Canadian Geographical Journal* March 1936)

²⁵Canadian Institute of International Affairs Toronto 1942

²⁶See *Canada's Western Northland* (Ottawa 1937) p 74

CHAPTER XXVI

THE ATTACK ON THE AUSTRALIAN ENVIRONMENT

A Coastal Exploration

Few chapters in the history of civilization show so clearly the effect of environment on the white settler as does that dealing with the three hundred years of Australian history. The effect so far is mainly economic, the racial change being barely perceptible. However, Hrdlicka's recent work¹ on the evolution of an "American type" should be consulted. It shows a slight but recognizable racial alteration through life in America. We may divide Australian history into two parts. The first deals with the discovery and exploration of the new continent. This may be said to extend up to about 1865. The last sixty years have been a period of exploitation, and we are now capable of assessing the resources of the continent, and can realize where nature is helping settlement and where she is thwarting it. In all other continents racial struggles have greatly complicated the issue, but in Australia there has never been an aboriginal problem of any importance, and there have been no struggles with any European power.

It is Australia's misfortune that, on the whole, her northern and western lands are distinctly unattractive. But it has often been pointed out that this certainly tended to keep Australia isolated from the civilized world until the British occupied it. This is perhaps a matter of congratulation only to the short sighted. It would have been better for the world to have had a large area of fertile lands than to have half that area preserved for a white race, which has to struggle for all time against the unfavourable environment of the centre, north, and west. Much may, however, be learnt from the history of the struggle up to the present time. We shall have no better key to future prosperity.

Almost the least known portion of the Australian coastline is along Cape York Peninsula in the vicinity of Cape Keerweer. Apart from one or two mission stations there is no settlement to this day, and the charts still show by broken lines the nebulous state of our knowledge. Here, early in 1606, the first authentic survey of the coast was made

¹*The Old Americans* (Baltimore 1925)

by Captain Jansz of the *Duyfken* and there was nothing in the look of the place—the mangrove swamps tea tree thickets and scattered eucalyptus—to tempt the Dutch or any other nations to settle there. They had in fact struck one of the least attractive coasts of all the winter-drought regions of which more anon (Fig 132)

The next great voyager was Hartogs who was even more unfortunate. He discovered in 1616 the only portion of the coast which receives a bare 10 inch rainfall. The name Dorré (i.e. barren) Island indicates the effect of the dry off shore trade winds which desiccate this coast for the greater part of the year. A little later in 1619

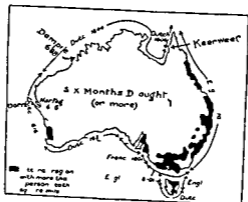


FIGURE 132 —The relation of coastal exploration to the close settlement of today. The English discovered nearly all the good areas

Houtman named the coral reef off Geraldton *Abrolhos* (Keep your eyes skinned) and here Pelsart's ship was lost in 1629. In 1623 Carstens in the *Arnhem* surveyed the coast of Arnhem Land which can still be described as a region of shallow waters barren coasts islands altogether thinly populated by divers cruel poor and brutal natives and of very little use. Here however high humidity and a sterile soil seem to be the chief disabilities for the rainfall is heavy during the summer. No settlement has ever taken place and the aborigines are reported to be almost as treacherous as when they murdered Carstens and eight of his crew.

In 1627 Thyssen explored from Cape Leeuwin right along the south coast for 1000 miles. He must have been favourably impressed with the thick forests of Karri (eucalyptus) in the extreme west but by a

fatality he turned back at Nuyts Archipelago just as the fertile south-east coasts were reached

In 1642 the first circumnavigation was made by Tasman. But he only saw the south of Tasmania and thence passed east to New Zealand. Two years later he surveyed the north coast, thus seeing nothing of the fertile south east and east coasts. Dampier was equally unfortunate. His two voyages of 1688 and 1699 added something to the world's knowledge of the north west from Derby south to North West Cape. This is precisely where the arid region touches the coast. The writer traversed this region by aeroplane in 1924. The great belts of floating desert sand, blown out to sea by the trade wind, made a memorable sight.

Cook, in 1770, was the first voyager to reach those portions of the continent, which—like all eastern coasts near the tropics—are beneficially affected by the constant trade winds or by the rain bearing systems known as the east-coast cyclones. It is noteworthy that his was a truly scientific expedition, and England has here reaped a rich reward from this but too rare example of her encouragement of science. For it was the authoritative reports of Banks and others which contributed largely to the founding of the first settlement in Australia. Cook reached Cape Everard in Victoria in 1770 and charted the whole east coast northward to Torres Straits. The "First Fleet" arrived at Botany Bay in 1788, and local exploring expeditions led by Bass, Flinders, and others had filled in the gaps in the south east by the end of 1801.

We may pause here to see how present settlement is related to the early discoveries of the coast of Australia. It is interesting to note that some sixty four of the eighty largest towns in Australia (i.e., those with more than three thousand inhabitants) lie in regions whose coasts were discovered by the English. Of all the littoral explored by the Dutch, from Cape York round westward to the eastern end of the Australian Bight, only the small region of the south west corner ("Swanland") is suited to *close* settlement by people of European origin.

The *exploitation* of the continent itself depends very largely on the structure, and this will now be discussed.

B Control by Structure and Geology

The structure (or build) of Australia is relatively simple, and a short study of the salient features will make the controls affecting

settlement much easier to understand In Fig 133 is given a "mantle map" in which the geological formations are shown laid one above the other in their true relation, though the edges of the formations (or "mantles") are necessarily exaggerated In the west appears the great Australian Shield (1 on the map), an area of very ancient rock for the most part, which has resisted folding and was worn down nearly to sea level in Tertiary times In late Tertiary times

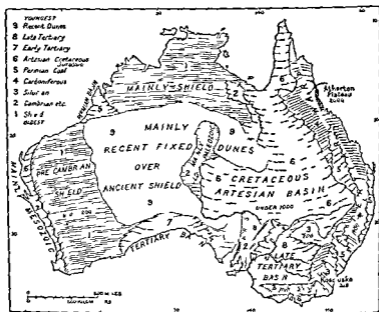


FIGURE 133—A mantle map of Australia in which the geological formations are shown in appropriate position (by exaggerating the edges). The main features of geology and topography are combined in a generalized fashion in this map (From *Limits of Land Settlement 1937*)

it was elevated *en masse* to an average height of about 1,200 feet It contains many valuable mineral deposits notably the West Australian goldfields but artesian water is absent except in one or two small basins on the margin A great deal of the Shield has been covered (since the Tertiary) with sand dunes (9) but slightly wetter conditions of late have enabled scattered vegetation to "fix" these dunes They are useless even for sparse grazing, and obviously prevent prospecting for minerals

Throughout most of the geological record the *Shield* has resisted the folding of the crust which has been so characteristic of the margins of the Pacific. But the eastern margin of Australia has been buckled into ridge and hollow in several of the geological periods. Ignoring the older examples in Permian times—some 150 million years ago—seas and lakes developed along a longitudinal hollow. In these lakes peat was deposited, to form coal under the pressure of later formations. These Permian areas are shown as 5 on the mantle-map.

Somewhat later, in Jurassic and Cretaceous times a great elongated basin (geosyncline) developed just to the east of the Shield. In this basin were deposited porous sands, which were buried by several thousand feet of impermeable clays, etc. The whole series is labelled

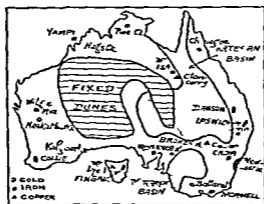


FIGURE 133a.—Minerals in Australia. Metals are found in the Western Shield or in the old rocks of the Eastern Highlands. None is found in the young basins (dotted) or fixed dunes. Coal is shown by black ovals.

6 in the map—and the porous sands in the lowest layers contain the largest artesian water supply in the world. A smaller basin (7) of similar character developed on the north of the Great Australian Bight. Here also artesian water (but of poor quality) is obtainable. To the south of the main artesian area is another broad basin covered with alluvial etc., by the largest Australian rivers. This is the Tertiary Basin (8), drained by the Murray and its tributaries, the Darling, Lachlan, etc.

At the end of Tertiary times probably before the Pleistocene (about one million years ago), the eastern margin of the continent was elevated in a broad earth fold. This was parallel to and associated

with, the earth folds which produced New Zealand and the numerous 'festoon islands' of the south western Pacific. This feature has been considered in Chapter VI (Fig. 29)

Structure in Australia as elsewhere determines the geography of a region, as this brief discussion indicates. Metal mines are found in the *Old* rocks exposed in the Shield, or in the eastern highlands and in the allied late uplift forming the Flinders Range (2) in South Australia. Coal mines occur not in these metalliferous formations but in the Permian (5) and later rocks, such as those labelled 7 in Victoria. Artesian water occurs in still later formations (6, 7, and 8). Good soils tend to accumulate in basins and similar low areas (such as 6

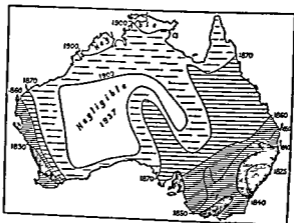


FIGURE 134.—Generalized map of pastoral occupation. There has been very little new land occupied since 1830. (Mainly after S. H. Roberts.)

and 8). Unfortunately these are rather dry areas in Australia. Soils do not accumulate on elevated regions to any great depth, hence the western Shield is only thinly covered except by wind-blown dunes. The rugged country in Australia is almost entirely confined to the region of late Tertiary uplift along the east coast or in South Australia. In the rest of Australia broad basins or a level Shield offer few difficulties due to topography.

C Spread of Settlement after 1788

We may profitably consider the major phases in the gradual settlement of Australia before discussing the factors which will

determine the sites occupied by future population. The "First Fleet" laden with convicts and their military guards was ordered to land at Botany Bay, because of the attractive description furnished by Captain Cook of that region. It is a curious coincidence that the original settlement should have been near what may ultimately become the natural centre of the population of Australia. I am tempted to place this in the lower Hunter Valley (near Newcastle) where valuable farm lands border on the richest coalfield in the Southern Hemisphere. Sydney itself is surrounded at a distance of 50 miles

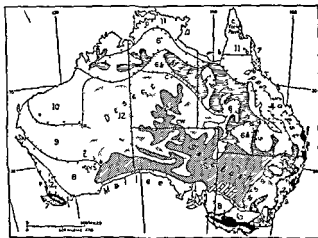


FIGURE 135 — Map showing distribution of the chief types of pasture in Australia (based in part on McTaggart). Classes 1 to 12 are numbered in approximate order of value. 1, temperate grass-land with differentiation of important areas of exotic grasses (closer ruling), 2 temperate forest, 3 tropical Mitchell grass, 4 open tropical forest, 5 salt bush, 6 tropical sandy grass land distinguishing as 6a areas in which acacia is more abundant, 7, rain forest, 8 mallee, 9 arid mulga, 10 west sandy grass-land, 11 poor open forest, 12 fixed dunes, 13 alpine. (Courtesy of *Geographical Review*, 1937)

by a zone of deep gorges (carved in a sterile sandstone plateau) which is even today nearly uninhabited.

The early attempts of the settlers to grow wheat in a land with a rainfall of 50 inches and a hot, wet summer, or to develop a sheep industry in the same somewhat unfavourable region, were naturally not very successful. Yet up to 1860 a considerable proportion of the wheat in New South Wales and Victoria was grown in such unsuitable wet coastal regions. Now, hardly any wheat and few sheep are found

in these regions. Until 1813 the infant settlement was hemmed in by the formidable 'dissected plateau' referred to above. Flocks and herds thereafter moved west into the broad, dry plains on the west of the divide—here about 80 miles from the Pacific (Fig 134). In defiance of the military governors, who wished to keep the settlers within range of the garrisons, they spread far and wide over the western plains. The convicts helped to develop the country till 1832 but thereafter more and more immigrants arrived. Even in 1830 there were 39 000 immigrants and free men as compared with 30,000 convicts.

By 1840 the pastoralists had occupied large regions behind Sydney, and smaller areas near Melbourne, Hobart, Adelaide, and Perth. A little later the splendid sheep country along "Mitchell's line" (from Portland to Albury in Victoria) was taken up, and by 1860 the squatters (ranchers) had pushed up the Darling River to Bourke. In 1860-70 occurred the greatest expansion of all (in Queensland) which is sometimes called the "Hegira". It will be noticed from Fig 135 that all the salt bush country, the best in the south, and almost all the Mitchell grass country, the best in the north, had now been occupied.

Meanwhile, gold was discovered in many parts of South East Australia in 1851 notably near Bathurst (N S W) and Ballarat (Vic). In July of this year an aboriginal shepherd found a mass of pure gold weighing 60 pounds near Wellington (N.S.W.). In the next twenty years (1851-71) twelve nuggets each from one to three thousand ounces in weight were dug up in Victoria. The effect of the gold discovery on the population may be gauged from the following figures

Date	1841	1850	1851	1852	1855	1859
Thousands	220	400	438	514	793	1 001

By 1870 all the important sheep country had been explored and in large part occupied. In the next two decades the remaining noteworthy stock raising region was leased. This is the Beef Cattle Belt which extends across tropical Australia from Broome (W.A.) to Townsville (Q). Reference to Fig 135 will show that it includes considerable areas of Mitchell grass. Since 1890 there has been little change in the distribution of cattle and sheep, though in many areas the density of stock has changed to a considerable degree. The chief new areas have been taken up in regions 8, 9, and 10 in Fig 135. They are clearly semi-desert areas where large areas are needed for each head of stock.

	MILLIONS OF SHEEP					Total
	New South Wales	Victoria	Queensland	South Australia	West Australia	
1890	56	13	18	7	3	98
1930	53	16	23	6	10	111

The table shows very little change in the total for Australia or in the figures for the states (except in West Australia) in the last forty years. The same is true for cattle which numbered 10 millions in 1890 and 12 millions in 1930.²

We may conclude this section by a brief review of agricultural development. Of the 22 million acres under crop in 1932 nearly 16 millions were devoted to wheat and 3 millions to hay. Moreover, the



FIGURE 136A—Spread of the wheat belt in Western Australia from 1888 to 1923. The isohyets for 9 inches and 15 inches (May/October) bound the actual wheat belt. (After R. P. Roberts and E. C. Clarke.)

B—Fluctuations in the wheat belt in South Eastern Australia. The dotted areas were wheat lands in 1860 but most of this coastal land is not now used for wheat. The ruled area is the wheat belt in 1924. (Partly after S. H. Roberts.)

larger part of the latter acreage is for *wheaten* hay. Oats is the second crop, but it has only about 2 million acres of crop. Hence we can confine our attention to wheat in this brief survey. The essential features in the spread of the wheat belt are charted in Fig. 136. In 1860 the areas cropped were in general too wet for satisfactory wheat farms and there has been a complete shift to the drier slopes further inland. The western edge of the wheat in 1884 is about the centre

²See the writer's comparison of the semi-desert pastures of Australia and the United States in *Economic Geography* July 1937.

of the wheat belt today. The advance still further inland in 1893 and in 1916 is charted as well as the present edge of the wheat which has not varied greatly since 1924. Indeed the fluctuations in the western boundary back and forth from 1893 to 1924 show that it is precarious to move into drier regions than the position reached in 1893. Hence it seems evident that the wheat belt in the south east (where three quarters of the crop is grown) is now in a fairly stationary position. A further discussion of this margin of close settlement appears later.

D Character of the Australian Population

Before proceeding to consider the controls governing present and future settlement it will be well to discuss the character of the Australian population. In several particulars this is rather unlike that of most other recently settled areas. In the first place the white folk have been free from the difficulties resulting from a large aboriginal population. The primitive tribes of Australia were so scattered so few and so poorly endowed in culture that they offered only a negligible opposition to the early ranchers and settlers. There have been many examples of minor conflict between white and black but nothing resembling a war or suggesting union of the aboriginal tribes against their displacers ever occurred. Today there are about 60 000 full bloods and 20 000 half castes in Australia. This is only a negligible proportion compared with the more than seven million whites. Moreover the aborigines are almost all to be found along the relatively inaccessible northern coastlands where they come in contact with only a few hundreds of whites.

Australia is perhaps unduly self-congratulatory on the fact that some 97 per cent of her white folk are of British ancestry. This is satisfactory in so far as it means that there is no language problem in Australia such as vexes Canada or South Africa. From the racial point of view Australia differs from Canada or the United States in that there are no immigrants from Central Europe. Hence the broad headed Alpine race is lacking though well represented in America by thousands of Russians Poles Austrians Yugo-Slavs etc. The present writer is of the opinion that biologically a strain of Alpine blood would strengthen the future Australian population. The British themselves are of mixed ancestry. Those from the rugged west of the British Isles are of Mediterranean race and are distinctly different from the fairer Nordics deriving from the eastern lowlands.

There is some slight evidence that the darker Mediterraneans may acclimatize more readily in Australia than the fairer type.

The first large group of non-British to arrive were valuable German settlers who took up land in the region north of Adelaide. They also migrated to the Wimmera and other places near the Murray River, and later many settled on the uplands west of Brisbane. Swedes and Danes helped the dairy industry in Victoria and the sugar industry on the north-east coast. The French and Swiss are largely responsible for the wine industry, especially in South Australia and Victoria. The Italians have always been associated with sugar, and the first large groups went to the Lismore district (south of Brisbane), but of late years they have become a dominant factor in the cane-fields of the far north near Mourilyan (lat. 16° S). Here they work at cane cutting under probably the hottest conditions of manual labour experienced by European labour. The latest data (from the 1933 census) are compared with those of 1921 (left), in the following table.

BIRTH-PLACES OF POPULATIONS

Australia	4,581,000	5,726,566
Britain	676,000	710,458
New Zealand	38,000	45,963
China	13,800	8,579
Italy	4,903	26,756
Germany	3,555	16,842
United States	3,257	6,066
Greece	2,817	8,337
Japan	2,639	ca. 2,000
Russia	2,317	ca. 2,000
France	2,088	?

E. Zones of Settlement^a

The chief aim of these chapters is to focus attention on those portions of Australia which will best repay exploitation, and incidentally to arrive at definite conclusions as to the relative merits of various regions in the continent. To this end I have summarized the various economic characteristics in a map. This represents conditions as they are now, 145 years since the first settlement. It represents the best guide to future developments (Fig. 137).

^aMany of the data in the Australian chapters are based on a portion of my Presidential Address to the Geography Section of the Australasian Association for the Advancement of Science, Wellington, 1923. A bibliography of this part appears at the end of Chapter XXIX.

There is now left that great central oblong of desert and semi-desert country whose successful occupation constitutes the great geographical problem of Australia. Its limits extend from Broome to Kalgoorlie and thence to Broken Hill, to Camooweal, and so back to Broome. The area contains practically 1,000,000 square miles. Until quite lately many people imagined that this central region constituted a great pastoral country. As near as I can ascertain, this huge area supports just over approximately 1 per cent of the sheep and just about 2 per cent of the cattle of Australia. I stress this because of its bearing on the problem of opening up the interior. We may subdivide this oblong block into the western useless sand ridge region, and an eastern portion with wings surrounding the former.

Noting now the distribution of cattle, the immense importance of the dairying industry can hardly be exaggerated. Taking New South Wales as fairly typical of the cattle states we find that practically half of the total cattle for the state are grazed in the small area of the northern rivers extending from the Tweed to the Hunter. This is the region of heaviest rainfall.

There is a belt of very much less importance on the table lands and only a small proportion in the western plains. Hence even in the great cattle industry, it is the farmer in the close settlement regions and not the cattle baron of the arid interior, who is contributing by far the greater wealth of the Commonwealth. In Queensland the same thing is true. The great preponderance of cattle is found on the farms of the well watered coast. The adjoining downs are less important, while the cattle in the lands too dry for agriculture are of very much less importance.

The control by climate is not so obvious in the case of manufactures, and is often quite unimportant in regard to mining. For very many years to come manufacturing in Australia will depend essentially on the presence of coal or of hydro electric power. The great coal deposits all lie almost entirely along the coast, from Fingal in Tasmania through Morwell in Victoria, the Sydney Newcastle region in New South Wales, and through Ipswich, Baralaba, and Clermont in Queensland. Without exception these districts would ultimately be closely settled if not a ton of coal were to be obtained, for they lie in the agricultural regions with a good rainfall (Fig 140).

Hydro-electric power is also dependent on a fairly heavy and regular rainfall, so that the chief centres must almost without exception grow up in this same region of the well watered east of the

continent Tasmania is in the lead at present, and many notable plants will soon have clustered near Hobart. The Victorian highlands and the New England slopes will some day have their short, juvenile rivers harnessed to the same end.

As regards metal mining, many examples of close settlement based upon this industry will spring to mind. But already Australia is seeing the end of several huge mining settlements. Coolgardie and Cobar are cases in point. Who can doubt that Kalgoorlie and Broken Hill will follow? They will have played their part in financing growing states but they are 'robber industries' in the American phrase, and replace nothing where they loot Nature of her treasures. Australia should, therefore, hesitate to spend money in mining, if it means starving the agricultural section of the community. For the wise farmer unlike the miner, leaves the land richer than he finds it.

It has been stated that the discovery of iron at Yampi (north of Derby, W A) and of wolfram, gold, and tin in the Territory will bring about close settlement in the Australian tropics. I can see no reason why this should be the case. Close settlement is not brought about by folk depending on such a specialized industry. What close settlement is there in Panama as the result of the canal organization? Or in Nauru Island in the Pacific, or in hundreds of similar rich tropical areas? In general the women and children of the labouring folk will be found to be left behind in temperate regions. Moreover, my impression is that to a large extent *unattached migrants*, who have no intention of settling permanently in such tropical lands form the main bulk of the employees. Tropical meat works at Wyndham, Darwin, etc., form perhaps an exception, for they may provide more permanent employment.

On the other hand, the sole asset of Australia which is rarely advertised by the publicists is the great coal belt mentioned previously. Here, indeed, Nature has bestowed riches which are unique in the Southern Hemisphere. I have shown elsewhere that the Newcastle coal is fourteenth among the world's coalfields. There are only three other fields of note in the Southern Hemisphere—Transvaal (eighth), Morwell, in Victoria (twenty third), and some little fields in the interior of Colombia (twenty fourth). We may legitimately hope to see a belt of manufacturing towns spring up in the east of the continent, and in fact the mushroom growth of the coal mining districts around Cessnock (near Newcastle) is an indication of what will occur at Morwell, Ipswich and elsewhere.

Indeed, around the Pacific there seem to be no accessible fields comparable with those of Newcastle for amount and quality though of course, inland in Shansi (North China) and in Western Canada there are very much larger coalfields. I need not point out how important is this asset of seaboard coalfields in connexion with the question of return tonnage in ocean trade (Fig 150)

The reader is referred to the author's recent advanced text book on Australia⁴ for a more complete study of the problems discussed in Chapters XXVI XXIX

F Recent Advances

During 1948 the author made four traverses of Australia with a view to estimating the chief changes in settlement since 1928. In Tasmania three new hydro electric districts have been developed to the south west of Great Lake near Tarraleah. In Victoria a new and immense open cut is being made in the coal deposits near Morwell. The steel works at Newcastle (N S W) are producing steel as cheaply as anywhere in the world. In South Australia irrigation is spreading to the south of Renmark and there are five barrages across the mouth of the Murray barring the entry of the sea into Lake Alexandrina. Water is being piped from the Murray to the iron district near Whyalla and Iron Knob. Blast furnaces and shipbuilding are developed at Whyalla. The coal at Leighs Creek in the far north of South Australia is much more abundant than was at first realized and is being developed. In Northern Territory a tarred road connects Alice Springs with Darwin and another good road links Camooweal (Q) to Newcastle Waters. Some promising gold mines are being opened at Tennants Creek and the mica to the east of Alice Springs is finding a good market.

⁴London Methuen ed 5 1949

CHAPTER XXVII

CLIMATIC CONTROL IN AUSTRALIA THE ARID LANDS

A Homoclimes of Australia

I have stressed the point that Australia after a century of progress should not be considered a newly opened country for it is commercially fairly well exploited. Yet there are many older-established countries and it is the province of the geographer to learn from them how best to develop the Commonwealth. The method of homoclimes enables us to judge what may best be done with the less-developed regions. I have demonstrated a graphical method of comparing homoclimes (i.e. *similar climatic regions*) in several earlier publications but some of the results may be discussed here. The table on the next page shows a number of the homoclimes of the tropical regions. Thus Banana is the homoclime of Broome and Durban of Brisbane. (The reader should also refer to the hythergraphs charted in Fig. 106.)

In addition we may note that Perth has among others homoclimes at Capetown and Athens. Sydney at Wilmington (North Carolina), Monte Video and Shanghai. Melbourne at Oporto (Portugal) and Valparaiso. Launceston at Falmouth (Cornwall) and Ancud (South Chile).

We need not here dwell on the economic possibilities of the cooler coastlands—no one doubts them. But there is a voluble section in the Commonwealth which believes that there is something much less unpleasant than usual about the tropical portions of Australia. A graphic way of bringing home to such folk the tropical character of much of Australia is to use the methods of comparison and superposition.

There is I fear no denying that the regions most akin in climate to tropical Australia as a whole are to be found in Northern Africa or Southern India. I cannot sufficiently stress the folly of those who without adequate correlative knowledge try to make forecasts of the development of Australia's *empty* lands from what has been done in the United States of America. A glance at Fig. 138 shows that we can compare the United States only with the southern *third* of Australia. The wonderful irrigation schemes of the United States are strictly comparable only with the irrigation schemes of the Murray

AUSTRALIAN HOMOCCLINES

In these two tables compare *A* with *A* *B* with *B* etc

Australian locality	Average temperature	Hottest month	Coldest month	Total rainfall	Rain Wettest month	Rain Driest month
	°F	°F	°F	in	in	in
<i>A</i> Broome	78.9	85.9	70.3	23	6	0
<i>B</i> Nullagine	79.8	85.9	70.3	23	3	0
<i>C</i> Carnarvon	71.0	80.0	60.0	9	3	0
<i>D</i> Wiluna	70.0	85.0	52.0	10	2	0
<i>E</i> Darwin	83.0	84.0	77.0	62	15	1
<i>F</i> Daly Waters	80.0	87.0	69.0	27	6	0
<i>G</i> Alice Springs	70.0	84.0	53.0	11	2	0
<i>H</i> Townsville	78.0	82.0	66.0	49	11	0
<i>J</i> Wyndham	84.5	88.3	76.2	27	8	0
<i>K</i> Brisbane	68.8	77.2	58.0	47	7	2

Foreign locality	Average temperature	Hottest month	Coldest month	Total rainfall	Rain Wettest month	Rain Driest month
	°F	°F	°F	in	in	in
<i>A</i> Banana (R Congo)	77.9	81.5	72.5	29	6	0
<i>B</i> Colima (Mexico)	76.1	80.0	69.6	34	7	0
<i>C</i> Olukonda (South West Africa)	72.0	77.0	51.0	19	5	0
<i>D</i> Windhoek (South West Africa)	67.0	74.0	56.0	15	4	0
<i>E</i> Cuttack (East of India)	80.0	87.0	70.0	55	12	0
<i>F</i> Quiveramobim (Brazil)	81.0	83.0	79.0	27	6	0
<i>G</i> Biskra (Algeria)	69.0	89.0	51.0	10	1	0
<i>H</i> Calcutta	78.0	82.0	65.0	60	12	0
<i>J</i> Tinneveli	84.3	89.5	78.5	28	9	0
<i>K</i> Durban	70.7	77.0	64.2	42	6	1

Basin They tell us nothing as to the development of the two thirds of Australia's empty spaces—e.g., the regions north of 30° S latitude

The most salient feature is the remarkable relation between the population and the rainfall. In the days of the great development of the United States (i.e., to 1900) the 20 inch rain line very closely

bounded the closer settlement country So also we must expect closer settlement in Australia for many years to be controlled by this boundary I have indicated (by dots) the Australian temperate lands with a 20 inch rainfall in the map, and it will be seen that Australia cannot expect more than about one fifth of the population of the United States as I have always maintained Still, this gives her fifteen million more settlers before she reaches a saturation corresponding to that of the United States today Such research shows clearly that the future *noteworthy* population of Australia will inhabit the regions already *moderately* settled

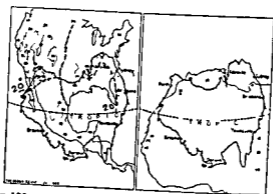


FIGURE 138—Australia superimposed upon North America and upon North Africa The American and African maps show isohyets of 10 20 and 40 inches The dotted area is the wet temperate land in Australia.

Leaving temperate Australia, let us try to find *homoclimes* for tropical Australia In earlier papers I have shown that we may compare the Australian desert lands with the Scinde (or Thar) Desert in India, while the hot, dry savannas and hot, moist coasts agree fairly well with the peninsular portion of India Unfortunately, tropical Australia is both drier and less elevated than tropical India A more useful comparison can be made by placing Australia over Northern Africa (Fig 138) This is a most convincing demonstration of the fact that the arid interior of Australia is exactly comparable in position and origin with the desert of Sahara I shall dwell on the differences in area and aridity in a later section We see in Fig 138 that the southern coasts of Australia agree with the regions of Algeria and Morocco and these are all Mediterranean in climate and resources, while Tasmania lies over part of France

There is the closest similarity in the width and position of the steppe lands on each side of the most arid region in both continents. The north south extent of the desert of Sahara and of the Australian desert agree. Of course, the great east west width of the Sahara is due to the presence of the huge land mass of South Asia which lies to the east of Africa. If Australia were as wide along the tropic, her desert might equal the Sahara in area and aridity (see also p 38).

On the equatorial side we find that the savannas of Nigeria are homoclimes of those in Northern Territory. Here also rainfall and elevation are remarkably alike, but the inland African region is slightly hotter. On the other hand it is watered by larger rivers than is Northern Territory.

It is important to note that some cotton growing is carried on in Nigeria, and we may yet see cotton fields in the Territory. Sorghum (and other millets) and tapioca (manioc) and groundnuts are largely grown also. While Darwin is not a particularly unhealthy place, it is significant that its homoclime is the Bight of Benin, "where few come out, though many go in." But no doubt the absence of natives and the rarity of tropical diseases, combined with the open coastline of Darwin, make Benin a less close homoclime than the following table would indicate.

	Temperature			Rain		
	Average	Hottest	Coolest	Total	Wettest	Driest
	°F	°F	°F	in	in	in
Darwin (N T)	82.7	84	77	62	15	1
Lagos (Benin)	79	82	75.5	72	18	1

B A General Discussion of Climatic Control in Australia

There can be no better guide to the future settlement of Australia than the present distribution of population. It is necessary to realize that there is no unexplored territory in Australia. With such vast areas of uninhabited country, it is obvious that detailed maps are not available, but no good pastoral country was missed by the later explorers, for they were almost invariably on the look out for new pastoral areas. By 1890 Australia ceased to be a pioneer country in the sense that good land awaited the discoverer. In the last half century the process of "filling in," and improving holdings already

leased or purchased, has replaced the pioneer's practice of "taking up" new country found by his own efforts

The map shown in Fig 139 gives a good idea of the division of Australia into two regions, to which I have usually referred as "Economic Australia" and "Empty Australia" The latter (included in the area ABCD) is unfortunately the larger of the two divisions It is amusing to realize that the writer was publicly censured in the Commonwealth Parliament as late as July, 1924, for drawing attention to these grave disabilities Today they are accepted without question



FIGURE 139—Map of Australia showing distribution of population. Urban population is given in thousands. *sparse* is about four persons to the square mile. *sparse* is about one person to the square mile. Area ABCD contains about 15,000 settlers. In the small wheat map the sugar area is shown black and the cotton area by dots.

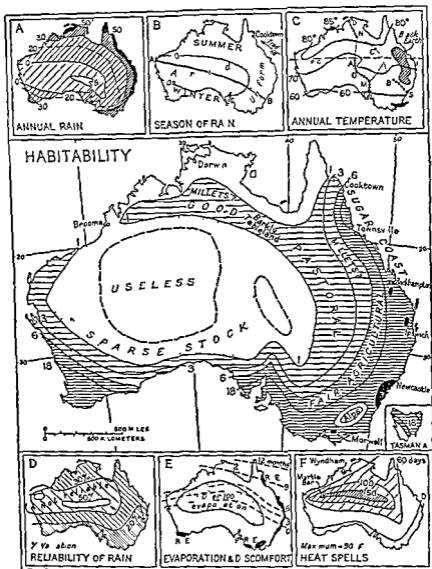


FIGURE 140—Future settlement of Australia showing approximate lines of equal population (to the square mile). Small maps: A annual rainfall; B seasonal rains (the line AB separates summer from winter rains); C temperature (the suggested railway routes are indicated from Alice Springs [A] or Bourke [B] to Newcastle Waters [N], Marree [M], Wyndham [W], and Marble Bar [B]); D rain reliability; E evaporation and discomfort; F regions experiencing long periods of heat (days over 90°F).

in the circular of the conservative Bank of New South Wales entitled *Australia's Vast Empty Spaces* ¹

Let us now examine with some care the climatic and other controls which have led to this very definite concentration of population in the east and south of Australia. If we consider first the position of Australia as regards *Latitude* it is so situated that the Tropic of Capricorn runs almost across its widest extent. Two important results follow—first that 40 per cent lies within the tropics—though luckily in the healthier because more arid part of the tropical belt—secondly that it lies in the domain where the trade winds (blowing from the east) are dominant.

The best test of the effect of temperature is shown in Fig 140 at *E*. Here the broken lines chart the *number of months* with a muggy climate i.e. each with an average wet bulb figure over 70° F. Thus Sydney has no such muggy month. Brisbane has three such months. Darwin nine and Thursday Island twelve. In the writer's opinion this is the major climatic disability along the tropical coasts and especially affects the white women who are the most important individuals in any scheme of permanent tropical settlement. Another function of temperature—lengthy periods with the dry bulb exceeding 90°—is charted in Fig 140 at *F*. These are called *heat spells* in Australia. They are most acute in the arid interior where 150 such days have been recorded. But in the writer's opinion the dry bulb readings are not so important as the *wet* bulb in discussions of settlement of tropical Australia since the discomfort due to a hot *moist* climate is the more likely effect in lands where tropical agriculture may flourish.

The rainfall régime is however the main control as is indicated in the introductory paragraphs. Since Australia so badly needs water it is rather surprising to find that the widest coastlands with a reasonably good rainfall (over 30 inches) are practically uninhabited. These districts are found along the north coast and are charted in Fig 140 at *A*. A reference to the second map (Fig 140 at *B*) shows us that down the east coast the rain is *uniform* as well as moderately abundant whereas along the north coast the rain falls almost wholly in the summer and there is little or no rain for nine months in the year. No agriculture has so far been found to pay under these conditions in Australia—though as we shall see this type of rain is

¹Aug 1936

found in Nigeria and allied areas with a considerable primitive population

Two other aspects of climatic control merit brief attention. There are many ways of evaluating the reliability of rainfall. The simplest is to find the average value of the *departures from the mean* for a long period of years. Referring to Fig 140 at *D* we find that the southern regions of winter rain vary *least* from the average, i.e., are most reliable. The thunderstorm rains of the centre are not only very small but very variable. The summer rains of the north are to be placed between the other two types in this respect. We have no detailed information regarding evaporation. Obviously it depends on the temperature and on the dryness of the air. Hence the lines of equal evaporation (Fig 140 at *E*) are more or less parallel to the sea coast but the greatest evaporation is found toward the hottest region in the north west. In the centre of Australia the rainfall is about 10 inches a year, but the evaporation is 100 inches a year. Only along the east and south coasts are there small areas where the rainfall is greater than the evaporation. These are shown as black patches in Fig 140 at *E*. Here accordingly (in a relatively humid atmosphere) vegetation flourishes with tropical abundance.

We have now briefly considered the most important of the climatic controls and Australia is so flat that it is on the whole devoid of *topographic* difficulties. However, there are unfortunately some rugged regions where close settlement has not taken place in spite of an excellent climate. These are found on the seaward slopes of the highland region already charted in Fig 133. In earlier publications I have tabulated such areas in eastern New South Wales. Their total area is about 23 000 square miles—nearly 30 per cent of the well watered littoral. In Victoria, an approximate figure for the rugged highlands (with a wet but rather bleak climate) would be 11 000 square miles, or one-eighth of the whole state. In Tasmania, about the same amount, some 11 000 square miles, is almost uninhabited (in spite of a heavy rainfall) owing to its rugged, bleak character. This is nearly half of the island state. In the other parts of Australia topography is not a controlling factor.

Artesian water is present in many parts of Australia. Indeed, in the north-east we find an artesian basin occupying over 600 000 square miles, which is the largest in the world. In general, all this water supply occurs in semi arid regions, where it is used for watering stock. It has perhaps doubled the grazing capacity of these areas.

but has had no effect on crop lands, and hence little effect on the population of the continent (Fig 133)

C *The Deserts and Arid Lands*

Popular opinion as regards the interior of Australia has oscillated in an interesting fashion during the exploration of the continent. The early pioneers noticed that many of the eastern rivers flowed to the interior. They concluded, therefore, that a huge stream, rivalling the Amazon probably debouched somewhere near Kimberley (W A). This theory gave place to the belief in an immense freshwater sea in the centre of the continent. Hence the early explorers gallantly carried boats in their attempts on the unknown inland regions of the continent. The journeys of Sturt Stuart, Warburton and others involved great privations, and led to very pessimistic views of the greater portion of the interior. Later it was found that the northern border of the arid country was excellent pastoral country, that the eastern portion was blessed with a wonderful artesian system, and that the centre contained some fair country in the ranges. This has caused the pendulum to swing to the other extreme, and a school of optimists has grown up who boldly state that the "desert" of the older explorers is a myth, and that there is no reason why stock should not thrive in every section of the arid interior. Moreover, they point to many areas where agriculture will (in their opinion) pay.

Some thirty years ago I commenced applying the methods of modern geographical research to this most important of the problems of Australian settlement. I regretfully came to much less optimistic conclusions than those usually current. It is no use, when one is studying a region such as Central Australia, to place much reliance on isolated reports. The factor which controls all settlement here is the climate and more especially the rainfall, and this is the most erratic possible. For instance, Barrow Creek (N T) (with an average annual rainfall of 12 inches) had 13 inches in the month of March, 1904. Next year the total *annual* rainfall was 4 inches. Onslow (W A) (with an average of 9 inches) had 11 inches in April, 1900 and 10 inches in May, 1900. Next year the total for these two months was half an inch. Such variations can be multiplied indefinitely. In our investigations therefore, we must keep certain geographical principles ever in mind and especially must we realize that a knowledge of *averages* of rainfall is infinitely more important here than in better-favoured regions.

It is perhaps as well to commence our discussion of arid lands by agreeing upon a definition of the word "desert," that term which is anathema to many Australian patriots. We may consider various opinions on the question. In a voluminous work entitled *Australia Unlimited*,² the writer (E. J. Brady) scorns the term as applied to Australia. He justifies his attitude by a lengthy disquisition on the merits of the so called "Ninety-mile Desert" near the Murray mouth. This region has an average and reliable rainfall of some 16 inches, and should not be classed with the great trade wind or rain shadow deserts. His remarks on this region, however, have no bearing on the true deserts of Australia, though he implies that the latter (in Australia) have been wrongly named in the same fashion.

Of more serious discussions we have two classes those of the botanist and those of the geographer. The former presumably often means by "desert" a region where there is practically no plant life. The latter, I believe, usually means a region where the plant life is too sparse to be of any important economic value. Cannon has recently studied the arid country of South Australia, and has adopted an "arbitrary classification" having 5 inches of rainfall as the criterion. This definition has no relation to Australian economic conditions, and is based on a much lower figure than in most definitions. Diels a German botanist, has adopted $8\frac{1}{2}$ inches, Schimper uses 10 inches. Milham, the distinguished American meteorologist, states that in the considerably cooler lands of the United States "below 12 inches is a desert." He agrees with W. M. Davis in this respect.

Various well known geographers who view Australia with a knowledge of other arid lands, write as follows. Professor H. E. Gregory, who has travelled throughout Australia says that she has "one of the most extensive deserts in the world." Colonel Lyons (the Egyptian authority) writes "Inland Australia has desert conditions as strongly marked as any in the world." Professor Ward, the American climatologist, uses 20 inches as the major climatic boundary in the United States. Sanders, in a recent discussion of Mexican climates, defines below 20 inches as "arid" and from 20 inches to 50 inches as "semi arid." This gives little hope of much of Australia!

I have left until the end the most useful definitions. Professor J. W. Gregory writes "The interior of South Australia is mostly a desert, using that term in its generally accepted modern meaning of a country with such an arid climate and such a scanty water-supply

²Melbourne 1918

develop it I have for years pointed out that Central Australia is exactly akin to the Sahara in its geographic location. We know that even the Sahara contains "no very long stretches without herbage here or there" ³

Since, however, the aridity of a desert varies with the distance from rain forming oceans the smaller Australian desert is much less inhospitable than the Sahara Desert. It has no district with a rainfall lower than 4 inches a year, while a large part of the Sahara appears to have less (Fig. 141)

There, however, appeared in 1922, a discussion of the world's deserts by the eminent geographer and botanist Koeppen ⁴. Here he discusses the controls governing deserts, and he has produced a world-map where one may see at a glance the relative extent of the great deserts of the world. Koeppen realizes that evaporation is a great factor in the problem, so that 10 inches falling in the winter is worth much more than 10 inches falling in the summer. His conclusions for desert country as they apply to Australia are as follows

RAINFALL AND LIMITS OF DESERTS

(After Koeppen)

Region	Season of rain	Average temperature	Total annual rainfall
		°F	in
North Australia	Summer rain	77	17
North West Queensland	Uniform rain	77	13
West New South Wales	Uniform rain	68	11
Southern lands	Winter rain	59	8

We see then, that Koeppen uses an average limit of about 12 inches but in hotter parts he includes 17 inches as desert, and in cooler parts nothing above 8 inches. With the exception perhaps of the Murchison region of West Australia these limits agree very well with the definition of J. W. Gregory.

However, the chief interest in Koeppen's work lies not so much in what he calls the Australian desert region, but in how it compares with regions treated in exactly the same fashion in the rest of the world. I have measured the areas given by Koeppen (see Fig. 141) in an approximate fashion. They are as follows

³See the writer's survey in *Geographical Review*, April 1930

⁴Classification of Climates (*Monthly Weather Review* Washington)

AREAS OF DESERTS OF THE WORLD
 (After Koeppen)

	Square miles		Square miles
1 Sahara	2 600 000	6 Colorado	200 000
2 Australia	1 100 000	7 Gobi	180 000
3 Turkestan	900 000	8 Kalahari	90 000
4 Arabia	480 000	9 Thar (India)	74 000
5 Argentina	400 000	10 Chili	74 000



FIGURE 142—The Western Tableland regions. The arid and desert divisions are stippled. (The Lake Eyre lowlands are also arid.) On the north the arid boundary is about 15 inches of rain. The desert area is based on soil character also.

We see that Australia contains the second largest area of extremely arid land in the world. Koeppen's figures agree almost exactly with what I have adopted for many years as the combined area of either practically useless or very sparse pastoral lands. Thus I quoted 590 000 square miles as useless lands, and 655 000 square miles as very sparse pastoral country, in the concluding chapter of my *Australian Physiography* (Oxford, 1919).

From the foregoing account it will be seen that there is a great variety of opinion as to what constitutes the "Desert" in Australia. In Fig. 142, I show the divisions of arid Australia which I have been using for some years. Before considering the exact limit of the desert, we may profitably discuss the following table, which gives the resources and population about 1924 in the various arid and west tropical divisions. They have not altered materially in the last dozen years.

Thus the "Central Belt," with 40 per cent of the area of the Commonwealth, contains only about one-sixth of 1 per cent of the population; 9 per cent of the cattle (less than one head per square mile), and 1 per cent of the sheep (less than one sheep per square mile).

SPARSELY INHABITED REGIONS OF WEST AUSTRALIA, SOUTH AUSTRALIA, AND NORTHERN TERRITORY

<i>Region</i>	<i>Area</i>	<i>Average rain</i>	<i>Average evaporation</i>	<i>Approx population</i>	<i>Cattle</i>	<i>Sheep</i>
A Western Desert	468,000	8	110	none	none	none
B Arunta Desert	59,000	7	110	"	"	"
C Arid Highlands	153,000	9	100	600	130,000	6,000
TOTAL, ARID CENTRE	680,000			600	130,000	6,000
D L Eyre Lowland	190,000	6	80	3,750	56,000	1,000,000
E NT Coastlands	270,000	30	90	2,300	450,000	none
F Kimberley, W. A	124,000	25	90	2,200	536,000	170,000
TOTAL, CENTRAL BELT.	1,264,000			9,450	1,172,000	1,176,000
Percentage, Australia	40%			‡ of 1%	9%	1 3%
G Far Western...	365,000	8	80	11,000	150,000	2,740,000
GRAND TOTAL...	1,629,000			20,450	1,322,000	3,916,000
Percentage, Australia	55%			‡ of 1%	11%	4 5%

When we realize that almost all this region had been adequately explored by 1879, and that within a year or two the borders had been taken up by pastoralists, it seems obvious that it is not ignorance which has kept it empty. Railways long ago in 1891 led to the heart of the arid region at Oodnadatta, they cross its southern margin at Ooldea, they almost reach the sand-ridge region at Laverton and at

*The Official Atlas of Natural Vegetation in the United States, 1924, states: "Between the Rocky Mountains on the east and the Cascade-Sierra on the west and extending from the Canadian to the Mexican boundary lies the great inland desert."

Marble Bar Sparse settlement has long taken place through Central Australia in the belt of better country between the two sand ridge regions, for the overland telegraph was built through here in 1872 Viewing all these facts, it seems to me that there is only one explanation Nature has been very niggardly in her gifts in the Australian hinterland While it is impossible to say exactly where the limits of the 'desert' shall be drawn, we must surely include the regions of sand ridges, which have repelled all settlement for nearly half a century, i e., since the borders were occupied

The layman's idea of a desert is usually erroneous, and is based on the extreme type seen near Cairo or the Red Sea These moving dunes without vegetation are by no means characteristic even of the Sahara Probably two-thirds of the African desert consists of *fixed dunes* like the Australian sand ridge country, or of *Areg* ('gibber' country) like that at Oodnadatta, or of *Hamada* like the rocky areas of West Australia Hence it is a matter of definition as to how much in excess of the two regions labelled "Desert" in Fig 142 would be given that name by foreign authorities on the desert environment Some like Koeppen would certainly include the far western area of 350 000 square miles as well as the 170 000 of the lowlands around Lake Eyre

To the writer it is on the *reasons* for the sparseness of the population (which is an unwelcome and unescapable fact), rather than on the name we give the country, that the attention of Australians should be concentrated

Let us now consider in more detail the pastoral problem in relation to arid Australia If we refer to the stock maps (which were first drafted by the writer in 1915), we find that cattle and sheep do well in certain regions of West Australia with only 8 inches of rainfall, while there is none in much wetter regions in Northern Territory The explanation of this anomaly lies in the geology of the regions A large portion of Central Australia is covered with sand ridges, where very little permanent fodder grows though even here it is possible to travel stock in suitable seasons Let us therefore, plot these sand ridges, and we find that they cover a large part of arid Australia and, indeed, agree fairly closely with the areas which are practically irreclaimable

The sand ridges extend from the south-east at Ooldea, on the Trans-Australian Railway, for a thousand miles to the north west at the Indian Ocean at Wollal, near Broome* In the south west they

*An excellent scientific account of this north west corner of the desert is given by F G Clapp in the *Geographic Review* New York April 1926

begin near Wiluna, and extend almost to Tennant's Creek, on the overland telegraph line. They cover about half a million square miles. A second area lies between Lake Eyre and the Barkly Table land (N.T.) and consists of about 70 000 square miles. The Arunta tribe dwell on the margins of this area. It may, therefore, be referred to as the Arunta Desert. This kind of country covers one-fifth of Australia, and merits a brief description (Fig. 142).

The sand ridges somewhat resemble those seen from the railway at Ooldea (S.A.), where some fifty miles of them are traversed. But here the rainfall is fair and the evaporation low, so that the region is much more promising than that to the north. The ridges are about 50 feet high, and tend to run parallel to the dominant winds. In the centre they are controlled by the south-east trade winds. It seems possible that these dunes consist of the finer material of the extensive desert sandstone formation of Eastern Australia, which has been blown to the west by the trade winds and piled up into ridges, of which four or five occur in each mile. While the western country will support travelling stock in favourable seasons, Talbot considers that it is never likely to be permanently occupied by pastoralists. However, the rainfall is sufficient to supply native wells and shallow soakage wells in most seasons. Thus Canning has opened up the stock route from Hall's Creek (Kimberley) to Wiluna (W.A.) by a series of wells, some of which give a supply of 1,000 gallons an hour. Very little, if any, use of it has been made in the last twenty years.

In much the same way as we may use the inner (arid) border of the wheat belt to determine the boundary of agriculture, so we may use the inner border of the sheep (SS) and cattle (CC) belts to determine the limits of settlement in the arid regions. These are shown very roughly in the map (Fig. 137). In the north and west cattle encroach closest on the desert, in the south sheep are the most important stock, although here also cattle occupy the roughest regions.

It must be clearly understood that this country of sparse pastoral occupation will never support much human occupation. The largest stations comprising thousands of square miles, rarely contain more than a score of white settlers, and of late years I believe the tendency is to work them with even fewer stock men than before.

Thus we may rule out all the region on Fig. 137 marked "No settlement" or "Sparse stock" from the point of view of noteworthy human settlement. It must be clearly understood that I believe that sheep and cattle will be much more densely distributed in the future.

in most of this cattle and sheep country. It is largely a matter of adequate wells and bores. But this by no means implies a dense population of human beings. Mining towns may, of course, spring up for a decade or two, but they do not materially affect the question.

The prosperity of the pastoralist depends very largely on the absence of drought years. This is quite distinct, of course, from the reliability of the rain, which has been discussed on page 393. In Fig 142A the seasons at Bourke, a sheep district in central New South

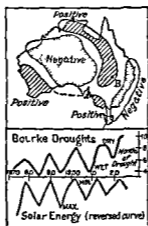


FIGURE 142A.—Map illustrating the possibility of forecasting seasonal rainfall in Australia. The graph (below) shows that rainfall at Bourke (B in map) varies directly with maxima of solar energy (i.e. positive relation). In arid Australia however years of minimum solar energy have rather better rainfall. (Partly from Kidson)

Wales have been graphed.⁷ The writer in 1922 noted that the drought years occur here during years with *low* solar activity (i.e., few sun spots). Later Kidson showed that this positive relation (i.e., low rainfall low solar energy) characterized much of the north and south of Australia while a negative relation marked the arid west. We have already noticed a similar variation for North America in Fig 88. Here is an indication as to how the sun spot cycle (recurring each eleven years) may help us in seasonal forecasting.⁸

⁷*Problems of Polar Research* (New York: American Geographical Society, 1923), p. 297.

⁸The subject is discussed at greater length in the writer's book *Environment and Nation* op cit p. 82.

CHAPTER XXVIII

FACTORS IN TROPICAL SETTLEMENT¹

A Population and Health in North Australia²

It must be admitted by all students of the tropical regions of Australia that we must be cautious in drawing conclusions based entirely upon the number and condition of present settlers. There are approximately only 180,000 people north of the Tropic of Capricorn. These figures should be considered in four groups, distributed somewhat as follows:

A. Rich east coastlands of Queensland	100,000
B. Inland Queensland (chiefly in east)	70,000
C. Northern Territory	4,000
D. Tropical West Australia	5,000

We note first that this total is a very small one, about 3 per cent of the total population inhabiting nearly 40 per cent of the total area. Furthermore, nearly all the tropical population has clustered along the east coast. Why is this? Not because of better steamer and railway transport, as some would maintain, but because the climatic conditions change entirely to the west of Cooktown. And this is very important, for it indicates quite clearly that the lands fall off in attraction as we leave the *uniform* rain region of the east and enter the *winter-drought* region of the north and north-west (see Fig. 140 at B).

For many years Australians have been inundated with literature pointing out the many advantages of tropical Australia. We have been told that it is a region of luxuriant forests, of fertile soils, of flowing rivers, and abundant minerals. It has often been stated that Australia has no coloured problem, and that tropical diseases are negligible. It is asserted that the elevation of much of the Territory (and I deal in this chapter more particularly with the Territory and Western Queensland) is so great that the temperature is lowered to quite comfortable conditions. We learn that the health statistics show clearly that this region is at least as healthy as the rest of

¹For references in this chapter see Bibliography on p. 421

²A detailed description of the various districts in arid or tropical Australia, and the factors controlling settlement will be found in the writer's book *Australia* (Chicago, 1931)

Australia, while the birth- and death rates are quite satisfactory. Finally, some writers boldly state that Australia has no "tropics"—that if the Tropic of Capricorn were reasonable it would move north and take up a position beyond Thursday Island!

It has been my special concern for over a dozen years to study this question, and my research may be described as one long period of disillusionment. First, one found that there were no luxuriant forests—there never are where a period of six months' absolute drought occurs. Next, one found that the soils in the coastlands, where alone the rainfall is abundant, are, as a whole, unusually poor. Many of the rivers in their lower reaches are occupied by the sea in their dry season, though heavy floods sweep down in the summer. The Tropic of Capricorn is, unfortunately, a rational climatic boundary, for the tropical coastlands are as hot as any tropics in the same latitude, except perhaps the Sahara. There is no region in the same latitudes with such a paucity of elevated land, even the Sahara having wide plateaux, whereas Australia has only the small Atherton Tableland. The Macdonnells and other regions over 2,000 feet are right on the boundary of the tropics.

It is, therefore, evident that there are many geographical factors to be considered in this problem, which have inevitably affected settlers in the Australian tropics, though perhaps they did not realize it. Health, communications, and soil fertility appeal to everyone, but climate comfort, labour supply, and markets are not considered as exhaustively as they should be. Let us study each of these potent factors in turn.

Health It is gratifying that the vital statistics of tropical Australia show it to rank very favourably among such regions. As I have pointed out however, the data are few in number, and as regards the *agricultural* regions of the tropics the population considered is only about 100,000. Personally, I fear the value of these figures depends entirely on the character of this small percentage of people. Are they typical of Australia, or do they contain larger numbers of men in the prime of life and fewer invalids, old folk, women, and children than usual? Ellsworth Huntington and Wynne Williams, whom I shall quote later, definitely state that in tropical Queensland the population is a "picked" one.

Doctors Breinl and Young, formerly of the Tropical Institute of Townsville, have published several papers of great value on tropical Australian settlement. They describe, first of all, results in other

parts of the world bearing on the problem. It has been shown that sunstroke is entirely due to heat combined with moisture. The mechanism in the human body, which so wonderfully keeps our temperatures almost constant, fails after prolonged exposure to such conditions. The great importance of the cooling due to perspiration is stressed throughout their articles.

We have here, I think, evidence in favour of the *wet bulb thermometer* as the best available test of comfort on the tropical coastlands of Australia. It imitates the human body in that it registers the temperature of the mercury as affected by the cooling of a wet linen jacket. Leonard Hill has improved on the ordinary wet bulb thermometer by greatly enlarging the bulb, and by measuring the rate at which the thermometer cools (under the local conditions) from 110° down to 90°. This closely approximates the cooling of the human body in the tropics owing to perspiration, etc. Breinl gives many readings, using Hill's katathermometer, and one would like to see this instrument much more widely employed. I point out in the next section that Darwin has nine months of high wet bulb, Rockhampton six months, Brisbane two, and Sydney none (not even in February).

It is extremely difficult to detect any marked physical change as a result of living in the tropics. Much of the so-called 'tropical anæmia' is no doubt due to hookworm and similar diseases. One must admit these, however, to be equally unpleasant, though probably they are tropical disabilities which science will render less dangerous in the future.

The chief definite disability resulting from tropical life is found to be *tropical neurasthenia*, which we learn is associated with depression, irritability, loss of mental activity, and power of concentration. As regards the actual health conditions, Dr Breinl gives figures showing that seven per thousand of the folks on the North Queensland coast have been treated in the hospitals, three per thousand on the central coast, and two and a half per thousand in the Brisbane region. This would seem to argue against the tropics, especially as the hot inland districts show somewhat similar high figures. Dr Breinl is satisfied, however, that this is due to the northerners having a sort of hospital 'habit,' and not to their being more unhealthy. I am not convinced on this point. One would expect that the sparser settlement of the north would be much less able to use hospitals than in the relatively closely settled south. There is no doubt whatever as to the greater number of admissions from typhoid, dengue, alcoholism, and 'damage

by violence in the north coast regions as compared with those in the south

In discussing conditions in tropical Australia, the eminent geographer, Ellsworth Huntington³ makes some pertinent remarks. He points out that the proportion of men to women is disproportionately large in much of the tropics (145 to 100). Furthermore, the percentage of men in the prime of life (20 to 40) is 17 higher in Queensland than in England and Wales. As regards women there is a larger percentage of *young mothers* and fewer old women in tropical Australia than in the temperate south. Naturally the birth rate of the north is benefited. Such figures mean we are dealing with a picked popu-

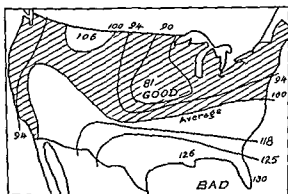


FIGURE 143—Mortality and climate in the United States based on three prominent insurance companies. Florida has the worst death rate and Nebraska Iowa the best. (After Huntington)

lation and that much better than average death rates should be expected in consequence.

The matter was debated at the notable Medical Congress in 1920 and those qualified to give an opinion were, I understand by no means so unanimously in favour of tropical settlement as some reports would lead us to believe.⁴ The best verdict to come to as regards the effect, whether good or evil of the tropics on the health of Australians is the Scottish verdict of *Not proven*.

Yet, if we get no definite guidance here there are other ways of

³*West of the Pacific* (New York 1925)

⁴See the report of the Congress in the *Medical Journal of Australia* Sydney Sept 18 1920 where a number of the grave difficulties are discussed.

studying the effects of the tropics, which speak with no uncertain voice. Thus we may see what the mortality tables show us for the United States of America. I have stated that there is no tropical region in the United States, but the accompanying map given by Huntington shows quite clearly the increase in the mortality in those states which most nearly resemble the Australian tropics. The hot, wet coasts of the Gulf of Mexico are very much less healthy than the cooler states of the north (Fig. 143). This map is based on the returns of three of the largest companies. It includes individuals who are chosen from the better classes of the community, so that Negroes and "poor whites" are largely excluded.

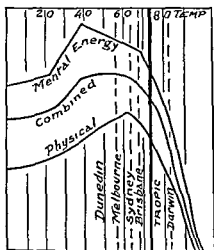


FIGURE 141—The temperature control of mental and physical energy (Based on Huntington). Note the poor position of tropical places in Australia.

Another suggestive graph by the same distinguished geographer shows that the best mental and physical work is done at temperatures between 30° and 70° F, and that there is a startling deterioration in all work done as the temperature rises above 70° F. The average temperature along the Tropic of Capricorn in Australia is 72° F, so that here we have the clearest evidence of a fundamental disability due to living in the tropics (Fig. 144).

The Australian tropics are remarkably free from the worst tropical diseases. Only malaria and hookworm are important, and we may anticipate their eradication by medical science. Some of my readers

will have in mind the history of the Panama Canal. They will know that malaria and yellow fever no longer have the mastery of that tropical region. But it is not generally known how arduous is the struggle to maintain healthy conditions nor has Panama much hope to give us as to close tropical settlement by true white *settlers*. I quote here from the account by J. B. Bishop of the climatic and labour difficulties which seem to me to be akin to those which Australia must be prepared to meet in her empty tropical lands. Mr. Bishop who was Secretary of the Isthmian Canal Commission writes in his book *The Panama Gateway* ¹

Has this expenditure [of some two million dollars] made the isthmus a health resort? In the full sense of the word it has not. It has made it a reasonably healthful place of abode and work only so long as stringent methods of health protection are enforced. Health statistics of the Canal Zone are misleading when used in comparison with like data of communities in the Temperate Zone. In the first place the American colony is a selected white community there are no aged and infirm persons to swell the sick and death rates. In the second place the health of the American colony is cared for as that of no other community on earth has ever been. The visitor does not see those who have been obliged to return to the United States because they could not withstand the climate and there have been a great many of these.

Mr. Bishop states that the death roll among employees from all diseases during the eight years of American occupancy to 1912 was 5,141 including 284 Americans. Forty nine American women and eighty seven American children died also. This is a much higher figure than most folk realize and the mortality during the earlier French régime which struggled along without any modern knowledge of the diseases which they were combating was only three times as much as far as I can learn. There were seven thousand cases in the American hospitals (out of forty thousand employees) during the year 1911-12 and Bishop adds that every clerk in his office had suffered from malaria though all of them occupied screened quarters.

B *The Discomfort Factor*

We may now pass on to discuss the next factor that of *comfort*. Personally I believe that an adult male employed in outdoor work can live as *healthily* in the Australian tropics as anywhere else. I do *not think that this can be said of the women and children who are even more important in the closer settlement problem.* But it is

¹London 1913

difficult to get convincing data, as I have stated before. When we come to the somewhat different but vital question of *comfort* there is no room for argument. It seems to me that this factor counts for more than health in this discussion. Admitting for the sake of argument that the northern lands are as healthy as the southern, it still seems clear to me that few settlers will endure the uncomfortable conditions of the tropics *as long as there is room for them in the south*. There is only one exception to this rule, and that is where the tropics offer much more profitable economic fields than are open in the south. Let us briefly investigate these two factors, *comfort* and *special economic attractions*.

NUMBER OF MONTHS OF DISCOMFORT

(Based on Average Monthly Wet bulb Data)

A <i>Very comfortable climate</i> (45° to 55° W.B.)		B <i>Sometimes uncomfortable</i> (55° to 65° W.B.)		C <i>Often uncomfortable</i> (65° to 75° W.B.)		D <i>Almost continuously uncomfortable</i> (over 75° W.B.)	
Wellington (N.Z.)	8	Wellington (N.Z.)	4	Batavia	10	Batavia	2
Coolgardie	7	Coolgardie	5				
Hobart*	6	Hobart	3	Thursday Island	6	Thursday Island	6
Melbourne	6	Melbourne	6	Darwin	6	Darwin	6
San Francisco	6	San Francisco	6	Madras	6	Madras	6
Alice Springs	5	Alice Springs	6	Alice Springs	1		
Sydney	5	Sydney	7			Sierra Leone	12
Perth	5	Perth	7				
London*	5	London	3				
Cairo	4	Cairo	3	Cairo	5		
New York*	4	New York	3				
Brisbane	3	Brisbane	4	Brisbane	5		
		Calcutta	3	Calcutta	3	Calcutta	6
		Townsville	3	Townsville	6	Townsville	3

N.B.—Places with a large number of 'uncomfortable' months (e.g., Batavia) have naturally a larger number of unpleasant days *per month* than those with few uncomfortable months (e.g., Alice Springs).

*These places have a few months in winter which are slightly below the optimum for comfort.

In my publication on the use of Climographs⁶ I have discussed fully the best way of clearly showing the discomfort of the tropics, so that I will here only insert the preceding table, which shows the length of the muggy, uncomfortable periods in some of the chief northern localities. Most folk dislike the hot, humid climate of Sydney in February. This is measured by the wet bulb average of 65° F. So that an average wet bulb of 70° F is very much worse than anything experienced in Sydney. Notice the good average position of New York in the warmer months.

This question of the grades of discomfort is still under investigation, but while better tests than wet bulb temperature will no doubt be devised yet I doubt if the relative positions of the places in the lists will be altered to any notable degree.

We are told that the discomfort factor is to be overcome by suitable housing, by electric fans, by air-conditioning, and so on. All these amenities are available to make life not unpleasant for the important official and his family. Thus one eminent authority has recently cited his healthy child, born in the Territory, as proof of the sustainability of the country for infants. This particular case is no more convincing than if Peary were to advocate close settlement of Northern Greenland because his equally healthy daughter was born there. No, it is the environment of the *labourer's* family which counts. I can see no hope of his wife receiving all the accessories (including domestic help) which are so necessary for the well being of the average mother under such conditions. Thus A. Despeissis writes of the Kimberley region in northern West Australia in an official publication:

It is unpleasant to record that a long sojourn in Kimberley tells on the womenfolk and their health often becomes severely affected.⁷ All honour to the poor pioneer mothers who have brought up families successfully in the tropics. They are heroines but I fear that the average immigrant of southern Australia of today shows little inclination, and indeed cannot be expected, to follow closely in their footsteps.

C Houses and Crops

With regard to the steps taken by the residents to meet these conditions of heat and discomfort, it is distressing to find the general

⁶ Control of Settlement by Humidity and Temperature (Weather Bureau Melbourne Bulletin 14 1916)

⁷A. Despeissis *The Nor West and Tropical North* (Perth 1921)

apathy This has been ascribed partly to a sort of fatalism, and partly to the migratory nature of much of the settlement The houses of the poorer folk in the interior are generally built entirely of corrugated iron At times there is no ceiling at all There is no attempt to modify the building in accord with latitude Indeed, in many cases the houses would not be tolerated even in cooler regions The white ant has driven them to build on piles, which is one good deed to its credit, for this permits free circulation of air beneath the house, but the obvious plan of permitting a similar circulation of air above the ceiling and below the iron roof was never employed in any permanent house I saw Yet the Government shacks for the "navvy" along the line make this obvious provision to obviate the presence of heated, stagnant air over the whole house Thatch is used at one or two stations, but *pisé* (mud), used so largely in tropic America, is said to be too expensive for small houses An iron roof is, of course, almost essential for water supply

I would refer my readers who wish to gain a vivid picture of what the life of the poor woman in the north of Queensland means to a lucid paper read by Mr Wynne Williams before the Country Congress in Brisbane⁸ Mr Williams was the Land Commissioner at Cloncurry in North West Queensland, and is carrying out valuable research in the living conditions in the interior He has lived for twenty three years in North Australia, and is one of our few writers who does not shun discussion of tropical disabilities While he believes that with satisfactory housing (which is not found at present) the health of the women and children will not suffer, he writes "The hot weather commenced last year in September, and did not abate till the beginning of May We have numbers of women whose lives have been confined day after day within these naked, scorching walls of iron for a period of eight months without respite I consider that the effect of these conditions upon the race can be as easily imagined as described" Further on, touching upon another vital problem, he writes "Try and imagine a woman bed ridden in the summer months on the western side of a galvanized iron maternity home, when in my own home (which is one of the best constructed houses in Cloncurry) I consider the rooms on the western side of the building unfit for occupation during the summer months" As a commentary on his statement we may consider the summer climate in latitude 21° S in Western Australia At Marble Bar in the summer of 1921-2 on an

⁸See *Brisbane Mail* Sept 3 1922

average the thermometer rose to 110° every day for three and a half months. The *lowest* maximum was 103°

D Economics

It is the economic factor which is still perhaps the most indefinite as regards the tropics. Sugar and many other tropical crops pay well along the east coast. White cane-cutters make good money in the sugar regions as far north as Cairns. They are the advance guard of the Anglo-Saxon race in heavy agricultural labour in the tropics. In the cooler, dry months the same men are engaged in meat works and in various trades connected with the cattle industry. I do not propose to dwell on settlement here save to point out that it holds out no great encouragement for settling the rest of the tropic coasts, where farming is a much more hazardous business, as we move westward (owing to the change from a uniform to a seasonal and variable type of rainfall). The sole notable crop in the Northern Territory, in spite of thousands of pounds spent in experiments, is peanuts. The harvests for the three years 1931, 1932, and 1933 were 410 tons, 175 tons, and 200 tons respectively. Only 30 tons were harvested in 1940.

The geographer would point out that the millions of tropical Asia are largely settled on great synclines or deltas filled with river silts (as in India and China), or on volcanic debris (as in Java). None of these occurs in the Territory, as far as I know, for the country is essentially a worn-down *peneplain of erosion* with widespread surface deposits of sterile laterite, quartzite, and travertine. Dr Jensen, one of the foremost soil experts in Australia speaks in no uncertain voice of the poverty of the soil in the following words:

Coastal soils. Fertile soils exist only in small alluviated pockets and in small coastal raised beach areas. The former are subject to floods and the latter of very small extent. Hill country. A few patches have a better soil (brown loam) suited for tobacco. The pockets of good alluvial soil are subject to heavy flooding in the wet season. Inland country. The soils inland are for the most part rich in plant food but naturally (owing to leaching) the richness of the soil varies inversely as the rainfall. But neither would there [here] be sufficient water for extensive irrigation nor would it be a feasible proposition since the soil would very soon be rendered too alkaline to produce anything.*

This seems to me to rule out the Northern Territory as a region of important settlement.¹⁰

**The Northern Territory* (Brisbane Royal Geographical Society 1917)

¹⁰The author's personal observations on his journeys throughout Australia will be found in his book *Australia* (Chicago Rand McNally 1931)

CHAPTER XXIX

FUTURE SETTLEMENT IN AUSTRALIA¹

A. The Industrial Probabilities

It is not impossible to grade the lands of Australia so as to see which are the most likely to have much larger populations—and which have little hope of ever supporting a notable population. Such an attempt is illustrated in the large central map in Fig 140. It sums up the deductions derived from the data in earlier chapters of this book. These “zones of settlement” may be classified as Industrial, Agricultural (temperate and tropical), Dense Pastoral (sheep and dairy) and Sparse Pastoral (sheep and beef cattle), and finally Desert areas. It is much more difficult to give absolute figures for the future populations in these zones.

The industrial possibilities depend almost entirely on coal. Only in Tasmania is there a hydro-electric plant of note. The total energy produced by this type of power is only about one per cent of that generated from coal, and though much more is available² it is quite negligible in view of the large coal resources of Australia. These are found mainly in three areas, which are all in the well-watered eastern region (see Fig. 140, centre).

<i>Coal Resources of Australia</i>	<i>Millions of Tons</i>
Newcastle—Bullh region	14,000
Morwell Brown Coal (Vic)	37,000
Ipswich, etc (Queensland)	2,000
	<hr/>
	53,000

The immense amount of coal in South East Australia is the largest in the Southern Hemisphere

We may surely forecast a great development of manufactures, based on this cheap power in the basin which surrounds and underlies Sydney. The Morwell brown coal is now used to produce power which is carried to Melbourne and other centres of industry, but it is

¹This chapter is condensed from an article contributed by the writer to a book *Limits of Land Settlement* (Report to the Tenth International Studies Conference, Paris, 1937)

²See Dresdner Bank, *Economic Resources*, 1927.

not of outstanding quality like that of Newcastle. Since the chief coalfields of Europe and the Eastern United States have led to population densities exceeding 100 per square mile, we may perhaps indicate three such future centres in eastern Australia at Newcastle, Morwell and Ipswich.

B *The Future Crop Lands: Wheat*

The agricultural lands of Australia are fairly clearly defined in the previous discussion. All along the coast in the rather restricted plains and valleys are prosperous dairy regions. Maize and fruits flourish in the north; oats and various temperate fruits in the south. We have, however, as noted, to subtract large areas of rugged country—totalling 45 000 square miles in the three south-east states—from this region. In the map (Fig. 140) the Alpine region, which is covered with snow for part of the year, is indicated, but rugged country extends to north and south of this area.

On the western slopes of the highlands in the temperate (southern) portion is the great wheat belt.² It is also the great sheep belt.

The south-eastern wheat belt contains 65 per cent of the crop lands of the continent (Fig. 136). In addition to wheat, only a small amount of alfalfa and oats is produced. The physical structure of the wheat belt has been referred to earlier in this article. It forms part of the great geosyncline in which deposition has been going on throughout later geological epochs. In late Tertiary times arid conditions led to the development of widespread dunes in the Mallee region—especially south of the middle Murray River. In recent millennia the rains have, on the whole, been better, so that the dunes have been vegetated and river alluvium has spread widely over the erstwhile arid areas. It is in this setting that the wheat farms have developed.

There are marked edaphic features in this region which are to some extent independent of rainfall conditions. Thus the arid edge of the wheat belt lies along the Murray River from Morgan east to its junction with the Murrumbidgee River near Balranald (Fig. 145). Rain isopleths now run to the north-east, but the wheat belt makes a sharp turn to the south-east near Finlay and thence goes to the north at Hillston. This marked bend is due to the unsuitable soils of the

²The valuable paper by John Andrews (see bibliography at end of chapter) has been used in the following section.

"Old Man Plain." To the west the Mallee type of soil, and to the south the Riverina type, are suitable for wheat.

The boundary of the "safe zone for wheat" is the boundary of the savana-woodland and red-brown soil region, while no successful farming has been carried on in the region of acacia-shrub and shrub-steppe. In South Australia this line has long been reached. In the east it is still on the arid side of the wheat belt. The 7.5-inch isopleth lies on this boundary and is thus a very important climatic and economic criterion. In the belt between the 7.5- and 10-inch isopleths, wheat can be grown successfully in "good years"—but even here there are so many "bad years" that the economic position is doubtful.



FIGURE 145A—Edaphic control in the main wheat belt of Australia. The present inner (arid) edge of the wheat belt is shown by the dotted line. B—Subdivisions of the wheat belt. The broken lines show the rainfall in inches during the cool months (April-October). Most wheat of today is grown in region 4, region 3 is unreliable, region 5 too wet. (Both maps are based on John Andrews.)

Andrews divides this characteristic wheat area into four regions according to their possibilities of settlement (Fig. 145, at B). *Region 1* includes the north-west around the Darling River where the rainfall is low (below 7.5 inches in the growing season) and erratic. The arid period is well above eight months in the year. Wheat has never been tried on these grey desert soils. *Region 2* (around Wentworth) is Mallee country akin to that in Victoria, and it was boomed in the "Million Farmers Scheme" of 1921 which the writer strongly opposed. The rainfall is low and variable, and there are few railways within 100 miles of Wentworth. It is clearly a very doubtful marginal area. *Region 3* includes most of the region where future considerable increase in wheat will take place. The reliability of rain is fair and it is served by several railways. The Roto area in the north has so far been reserved for stock, but it is said that there are 850,000 acres thereabouts where wheat may be grown. On the Lachlan River, a large

dam has been built near Wyangala and it is probable this will materially improve conditions near Roto and Hillston. Near Roto a farm of as much as 600 acres is needed, so that a farmer may have 350 acres used in a rotation scheme of fallow wheat oats pasture, with 200 acres in addition for horse paddocks, etc.

Region 4 (Fig 145, at *B*) is the main wheat belt of today. It has reliable winter rains, for the most part between 10 and 20 inches in the winter months. Present policy is to concentrate on this area, and open no new farms in the debatable areas 2 and 3. By the use of superphosphate, and by increasing water supplies in dams, etc., for sheep, the better-class farmers are prospering in much of this region. The Wakool area is being supplied with water (for sheep) from the huge Hume Dam on the Murray near Albury.

Region 5 (Fig 145, at *B*) This area receives 20 inches of rain during the growing period. It is rather rugged, and wheat is in places giving way to other crops and industries.

In the south of Europe such wheat country has more than 25 folk per square mile. I have labelled it "18" in my tentative map. In the smaller tropical area to the north, cotton and "Indian" types of wheat can be grown inland from Rockhampton, while sugar and tropical fruits (bananas, pines, etc.) will no doubt spread along the coast, in addition to the successful dairies (Fig 139, wheat map).

The isolated wheat region of Western Australia is charted in Fig 136 at *A*, taken from a map by R. P. Roberts in Clarke's⁴ discussion of the water supply in this region. The gradual spread of the wheat over the Shield, until the belt is nearly 200 miles wide, occurred between 1888 and 1928. It is remarkable that successful wheat can be grown in the shallow soils resulting from the decay of the ancient rocks of the Shield.

C Possibilities of Tropical Agriculture

There are, of course, two fairly important tropical crops in Australia. Sugar (Fig 139, inset) to the extent of half a million tons was produced in 1933. A newer crop is cotton, which has developed since 1921, when 2 000 acres were picked. In 1924 this had risen to 50,000 acres. It has not increased much since that year. The centre of production is right on the tropic near Rockhampton (Fig 139, inset). Both crops are only maintained by the help of heavy "pro-

⁴E. C. Clarke *The Water Supply of Western Australia* (Perth 1936)

tection" There is no doubt that cotton could be grown far more widely in the Queensland littoral if the demand arose. The black soils in this region (see Fig 140, at C) are practically unused.

We owe to Wynne Williams a timely discussion of possibilities of the Australian tropics. He has been in a position to examine them closely both in Northern Territory and in Queensland where he has held official positions connected with pioneer settlement for a quarter of a century. He has discussed at some length most of the coastal regions (traversed on a journey northward from Brisbane) in the Australian *Economic Record* for June, 1935.

Just south of the tropic is the Government Project at Theodore on the Dawson River (Fig 139). Here the total rainfall is 28 inches—and water from the Dawson was provided for about nine irrigations per year. In 1927 settlers were invited to make their homes in "this valley of content." 264 farms were occupied, but in 1935 there were only 124 settlers living there, many of them in a state of poverty and discontent. It cost \$42,000 to place each settler! The failure was partly due to the sub-tropical rains flooding the irrigated areas.

Even south of Rockhampton the pasture in summer becomes so dry that dairy cattle cannot be properly grazed. From Rockhampton to Townsville, a distance of 400 miles, there are only two agricultural areas of consequence where irrigation is not necessary. One is at Mackay where sugar and dairies occupy a rich district about 40 miles wide. The other is at Proserpine, where there is another unirrigated sugar district. There are also two other agricultural districts mainly based on irrigation at Bowen and Ayr. In both cases water from shallow gravels is obtained by pumps, and is used for the growth of cane. At Townsville—though it has 16,000 inhabitants—there is no important agriculture, for poor soils and a marked dry season prevent its development (Fig 139).

About 50 miles north of Townsville begins the largest area of true tropical forest in Australia. It is a narrow fringe extending for 240 miles along the coast to Cooktown. Here is the sole tropical table land (Atherton Plateau) of any significance in Australia. Below the seaward scarp are the richest sugar plantations at Mourilyan, Cairns, and Innisfail. On the plateau (2,000 feet high) were thick forests which have now in large part been cleared. Mareeba is the chief town on the plateau, and is in the vicinity of many tin mines (Fig 139). It is only 25 miles from the sea, yet already the rainfall has dropped to $2\frac{1}{2}$ inches in the three months of dry season. Ac

According to Williams all attempts to produce profitable crops failed until tobacco was started, and the success of this is not yet assured. In the remaining portion of the tropics Williams corroborates the findings of the writer in 1918 that conditions are so much less favourable than on the East Queensland coast that it is foolish to attempt to settle farmers therein.

As regards the drier hinterland of Queensland the present writer is a little more optimistic than Mr Williams. Considerable areas (with similar dry seasons) are able to support a noteworthy population at a relatively low scale of living in India and South East China. As shown in Fig 140 at C it contains the best black soils in Australia. It will doubtless need much experimentation before the best crops to use are discovered. I believe however that the future will see agriculture spreading through the belt labelled Fair Agriculture in the map (Fig 140). Its future population is tentatively placed at from 6 to 18 per square mile. Since at present the population in this belt is only about 2 per square mile there is room for many more settlers in this area. In the south west corner of the continent (Swanland) this region of the future development of the wheat belt is also labelled 6 to 18. Here the population today is almost negligible for difficulties of soil water supply and poison plants still remain to be surmounted.

There is a sharp transition at the 6 isopleth from crop-lands to the purely *pastoral* country of today. In the United States (in cooler lands) this isopleth agrees with the 20 inch rain line so that the Australian forecast represents a greater saturation than in the United States. I feel sure that in the hotter areas millets of the Nigerian or Sudan type can be grown but there are no reliable data on this point. In homoclines in North Africa the population varies from 2 to 25 per square mile and the same is true of the region in the hinterland of Rio de Janeiro with a somewhat similar environment.

D The Main Pastoral Belt

Most of Australia is a purely pastoral country and here as in other arid countries the cattle and sheep need large areas per head for grazing purposes. Moreover water supplies are limited in the lengthy dry season which characterizes *all* the purely pastoral country.

The sheep population in Queensland has not increased more than 10 per cent beyond the 1891 figure in spite of nearly 45 years of closer settlement improvement in watering facilities and the building of railways to facilitate transfers of stock in drought years. Thus it

is estimated that in Queensland, owing to drought from 1926 to 1932, there was a loss of 11,564,000 sheep

The experience at Mutooroo (a large sheep station in South Australia about 200 miles north-east of Adelaide) shows what can be done by enterprise and brains (Fig 139) In this area the rainfall is only 7 inches a year It is fairly reliable and falls mainly in winter The vegetation is largely salt bush (*Atriplex*) which sheep eat greedily There are no rivers or artesian supplies and an expenditure of \$500 000 was necessary to provide artificial water holes ("dams") and supply-drains This vast sum enables the owner to carry 33 sheep to the square mile Thus each sheep under such conditions needs 20 acres for its sustenance Obviously this sort of expansion is beyond the powers of the ordinary settler, and will not do much to increase the population of Australia In the north of West Australia are some of the largest ranches in the world Thus Ord River Station formerly covered 4,400 square miles, and grazed 80,000 cattle Yet this huge territory was managed by a white population of only 40 people with the help of about 70 aborigines

In Australia cattle are found in the hotter, rougher lands, while sheep are in the cooler regions where water is more abundant (Fig 139, insets) Cattle can graze 10 miles from water, whereas sheep need a well or waterhole within 5 miles This factor has much influenced the character of the settlement in many parts of the pastoral area The writer has recently discussed the different controls in the United States and Australia in his paper on American and Australian deserts (see Bibliography) Sheep and wool have paid well in most recent years, beef cattle have been for the most part a losing proposition ever since 1910

The beef industry in the tropics labours under considerable climatic difficulties Very soon after the end of the wet season the grasses dry off, and their nutritive value decreases rapidly By the end of the dry season stock are generally in poor condition, tick fever weakens them still further and the mortality is high, especially if the start of the wet season is late Under these circumstances cattle take a long time to mature and this factor alone will prevent the far north of Australia from developing into a second Argentine in producing cattle for the chilled beef trade⁵

Hence there has been a shift from cattle to sheep where water can be obtained and where the country is not too rough, hot, or sub

⁵Bank of New South Wales Circular, 1936

ject to pests like dingoes (wild dogs) Wynne Williams gives a valuable discussion of these problems in his paper on the Barkly Tableland on the borders of Queensland and Northern Territory (Fig 140) Here is a strip of country about 500 miles long and 100 wide receiving from 15 to 20 inches of rain where Mitchell grass grows abundantly On the coastal side the rainfall is heavier but the grasses are coarse and not nutritious On the southern side the desert begins where the rainfall is less than 15 inches There is little permanent water—but about 130 bores have been put down to a depth of 200 feet Each of these costs several thousand dollars to equip—and each bore waters about 3 000 cattle Williams is of the opinion that it is possible to change over from cattle to sheep in most of this area If this were done he thinks that 4 acres would support 1 sheep as suming an adequate water supply were obtained (by bores to the ground water) He forecasts that three million sheep will be grazed on the tableland if his suggestions—involving large initial outlay of course—are followed

Much of the region labelled *sparse stock* in the main map in Fig 140 may in the far distant future be developed in the same way as Mutooroo—but this cannot greatly increase the population, and is only possible for settlers commanding large sums of money When we turn to the last areas those labelled *Useless* in the map the writer is convinced that we have nothing to hope from them

In the present chapter the writer is concerned primarily with the expansion of the present population by natural increase or by immigration It is unnecessary to state that Australia has had her unemployment problems like all other young countries Hence the influx of immigrants in the future is likely to be a slower process than when large areas of first-class country were available The cost of settling a farmer—as described in this chapter—must be borne in mind Regarding settlement by peoples of lower standards of living one can only state that there is nothing in the Australian climate to deter any Asiatic or Central European populations It is largely a matter of methods of work The Chinese works a farm of 4 acres the European one of 40 acres the Prairie farmer of Canada needs 400 acres These aspects would seem to concern the sociologist and economist rather than the geographer

The forecast made by the writer over twenty years ago is now generally accepted by Australians It was to the effect that the future millions of Australia are going to find their dwelling places and occu

pations in the lands already known by 1865. The Empty Lands of Australia are a burden to the Commonwealth rather than an asset and their vast potentialities exist only in the minds of the ignorant booster. Yet the six millions of Australia possess in the south and east of Australia one of the best areas in the world for white settlement. In this quarter of the continent the writer expects that some twenty millions will dwell when Australia is developed to the same extent as the United States. If we adopt the lower standards of Central Europe and elsewhere and assume that the coal is adequately used for manufactures then there seems no good reason why this figure should not be doubled or trebled. Whatever the final population the *relative densities* will be arranged somewhat as in Fig. 140.

The author visited Australia in 1948 at the invitation of the Commonwealth education authorities and found that problems of settlement were being treated in a very different spirit from that of thirty years ago. Australia has reached scientific maturity. Government publications now chart a large part of central and west Australia as desert. The wild schemes based on Bradfield's project for watering the interior from the few small rivers near Townsville are being subjected to strict official criticism. Best of all the authorities at Canberra are sending out six parties of scientists—including a number of geographers—to typical areas in each of the empty regions of the continent. After many months in the field the reports of these parties will serve to give a much more complete picture of the possibilities than has hitherto been possible. The author will always remember with pleasure meeting many of these scientists at a conference in Canberra. They were good enough to record that my early work on similar lines served as a foundation for their investigations and that later research had corroborated my findings.

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PART IV

THE FUTURE

THE CONTROL OF THE POTENTIAL WHITE SETTLEMENT
OF THE WORLD BY ENVIRONMENT

Part IV of this book follows closely my paper published in the *Geographical Review*, July, 1922, entitled "Future White Settlement". The conclusions, as shown in Fig. 155, are so like those recently given in Pelzer's map (on p. 340 in *Limits of Land Settlement* 1937) that I feel it unnecessary to change the section greatly. However, further data have been added regarding Siberia and East Africa. N.B. The term "White" refers to folk of *European* culture. It is not a racial distinction.

THE PROBLEM STATED, AND METHODS
OF RESEARCH*A Introduction*

The story of the evolution of our own race, and of its wanderings over the face of the globe, and of the paramount control exercised by environment, is truly interesting. But it is even more interesting and, if one can do it with any accuracy, even more important, to forecast the future migrations and history of "white" settlement. While the following chapters do not pretend to give an accurate forecast, it is hoped that they will indicate the physical controls which must play a very large part in future white settlement. In so far as we plan with due regard to these controls, we shall be facing the future in a scientific spirit, and such an attitude must make for the good of the nation concerned.

It is usual to be met at the outset of any such attempt with two criticisms. First, that this problem as to the future is too difficult owing to the complexity of the factors, and second, that there is little need for anxiety for the morrow, for science will always be able to cope readily with any problem of food supply. The first argument is merely a challenge to the enthusiastic student, who does not expect complete success but only desires to help human progress in some small degree. The second argument assumes that because science has done wonders in the last century, similar wonders can be done indefinitely.

I know of no writer who expresses the very special environment which controls the food supply of the world *today* so sanely as E. M. East of Harvard. I quote extensively from a notable article of his, entitled "Population in Relation to Agriculture"¹

The world is not as big as it used to be. It has shrunk tremendously in the past few years. It is difficult to realize the change that has taken place in our outlook on many economic problems due to this globe-girdling with easy means for commercial transactions and for personal migrations. Squatters have already camped on the choice spots of the earth's surface and those who come after will have to take the by ways and hedges and the stony ground.

The human race has had a history of at least 10 000 years since it developed enough mentality to leave written records yet in all this time the natural increase was so slow that in the year of our Lord 1800 there were only some

¹See his chapter in *Eugenics in Race and State* (Baltimore 1923)

850 million people. Since that time in a hundred years the population has doubled [In 1924 it was stated to be 1 841 millions]

The world has had a continuous natural increase annually for the past century of about 0.7 per cent. and the increase at present is greater than at any time in the past. My own estimate of this current annual increase is 15 million. In 1800 not a single country had reached a point where the population was pressing heavily upon subsistence in present day terms. Today the story is different. China is full to overflowing. India and Japan have passed the saturation point according to Western standards of living. The Australians living on the rim of a barren desert bowl are increasing at the rate of about 18 per thousand a rate which their agricultural possibilities cannot stand for long. Our own United States have reached the point where there are diminishing returns in crop production.

A careful study of available statistics shows that it takes about 2.5 acres to support each individual. It is therefore necessary to cultivate some 37 million acres more land each year than was ever so treated before. Take out the mountains, deserts, the undrainable swamps, in short, the areas not available for agriculture and there is left 13 000 million acres (out of 33 000 million acres of land). Of this potential world farm, some 5 000 million acres are now being cared for by the hand of man. The total available of 13 000 million acres will support a little over 5 000 million on people. [This is less than three times the present population of the world.]

Dr East next considers the optimism of certain agriculturalists who pin their faith to scientific research. He writes:

Useful variation in the domestic plants and animals is very rare. The real point of attack is through hybridization, yet even here it is doubtful whether a betterment greater than from 10 to 20 per cent. can ever occur. The true increase in production by more efficient methods of farming may be as high as 50 per cent. But it is offset and masked by the bringing into cultivation of poorer new lands. I cannot see in this prospect anything but temporary expediency. *In any permanent system of agriculture the soil and the climate are the true arbiters of production.*

In the United States Dr East considers that three quarters of a billion acres must forever be withheld from agriculture. There is left 300 million acres (roughly equal to 35 per cent of the present farm lands) which may in the future be incorporated with the farms. The same state of affairs is more or less present all over the world for the first time in history. We are using nearly all nature's resources to feed the present population. Thus Dr East agrees with other economists that the food problem will be very difficult in the near future.

Dr Baker is somewhat more optimistic² and sums up the problem as regards the whole world in the following important table. We see

²O. E. Baker in *Geographic Review* 1923

that only 4.2 million square miles, out of 52.0 millions, are *potentially* arable, and remain to be exploited by future generations.

ARABLE LANDS OF THE EARTH
(From O. E. Baker, *Geographic Review*, 1923)

<i>Lands</i>	<i>Tropical and subtropical</i>	<i>Temperate</i>
	Million square miles	Million square miles
Too arid for crops	80	76
Too cold for crops	..	64
Not arable	100	100
Pasture, but arable	06	15
Cultivated	12	25
Potential arable	32	10
<i>Total land area</i>	230	290

B. General Method Used in the Present Research

With the passing of many purely artificial military and political boundaries, we may look with more certainty to a time when the unrestrained economic resources of a region shall be the controlling factors in determining its prosperity and the density of its population.

Ever since 1909 the writer has been engaged in economic physiographic research in regard to the continent where such problems are presented in their simplest form. Australians are free from the race problem, while the climatic controls are relatively simple and are not confused by great topographic variation. At the same time, a large range of climates from the hottest tropical in the north-west to the cool temperate of Tasmania is involved in such physiographic research.

In papers listed on page 421, I have determined³ for Australia the temperature (and humidity) controls governing white settlement, and the temperature and rainfall controls which determine the economic limits of the main industries. In 1918, I published a map showing how the future settlement of tropical Australia might reasonably be expected to be distributed.⁴

³"Control of Settlement by Humidity and Temperature" (Weather Bureau, Melbourne, Bulletin 14, 1916).

⁴*Settlement of Tropical Australia* (Brisbane, Royal Geographical Society, 1918).

The present discussion is an attempt to carry out a similar investigation for the world as a whole. I have confined my study to the so-called "white race" (i.e., the settler of European descent), because data as to its climatic controls are available. This is not the case so far as I am aware with regard to the Asiatic or Negro peoples. It is unnecessary to add that the Asiatic peoples will continue to spread beyond Asia but this aspect is not discussed.

It is obvious that the European peoples have no opportunity or wish to supplant the yellow or black folk in the regions of the Old World extending from Liberia to Japan. This limitation is, I trust, sufficiently indicated by the boundaries in the resulting map of future populations (Fig 155). I have, however, thought it of interest to carry my investigation into these debarred regions—though here the results are outside the realm of practical geography.

The problem falls into three divisions. First, it is necessary to decide on the major controls which determine white settlement. Secondly, we must assign relative values to these several controls. Thirdly, we must classify the many diverse regions of the world, so that each unit shall be capable of quantitative consideration in terms of the controls determined upon.

My method has, therefore, been as follows. I have subdivided the continents into seventy-four economic regions. These are shown approximately on Fig 154. They are much the same as Herbertson's "natural regions" in the temperate zones—but my studies of tropical Australia have led me to distinguish other types in the torrid zone. The units are therefore much more numerous than in Herbertson's map.¹ Each of these regions is tabulated in terms of what seem in the writer's opinion to be the four dominant controls (temperature, rainfall, location and coal reserves). A quadrangular graph—the *econograph*—is constructed for each region. The area of this graph is found to represent approximately the habitability of the region concerned.

Lines of equal habitability (*isokeles*) are drawn on a map of the world. Using the present European populations as a criterion, it is shown that these *isokeles* may be translated into isopleths of future population.

The map indicates that white settlements will tend to congregate around five world centres or *clusters of cities* of a type which Geddes has named *Conurbations*. These are near London, Chicago, Sydney,

¹*Sensor Geography* (Oxford 1908) Fig 1

Durban, and Buenos Ayres Of these the United States' centre will probably be the largest

C Economic Regions

In an investigation which contains so many variable factors, the 'personal equation' of the writer is bound to enter to some extent The only way to counteract this is to classify the regions involved carefully, and then to allot their economic values according to a fixed scale

The economic areas which I have used are shown in Fig 154 and the areas in square miles are given in the table on page 452 I have inserted the boundary between Europe and Asia in Herbertson's map The European plain varies so greatly in its economic resources that I have divided it into three units approximately depending on the temperature In Asia the Siberian belt is also separated into a western lowland and an eastern highland portion The north and south halves of China differ greatly in resources and are subdivided

It is in the monsoon lands that I have modified Herbertson's regions most largely, both in Asia, Africa, and Australia Diverse topographies and differences in the rainfall types determined the subdivisions The Sahara and Australian Arid Regions are divided in accord with the line separating the summer from the winter rain regions This is, however, not of great economic importance In America the alterations are not marked I have extended the tundra region to the south, and separated the Utah region from Alberta

The areas of these regions are given in the first column of the large table which appears on page 452 They were determined by planimeter and are approximate only I have named the region in accord with the chief country or province included, but the economic and political boundaries rarely agree

D Temperature Control

A glance at an ethnographic map of the world will show that temperature is the primary control in determining the distribution of the white settler but the optimum temperature and the upper and lower limits require considerable investigation In a former paper⁶ I give reasons why 50° wet bulb and 75 per cent relative humidity are near the optimum for white folk Unfortunately few countries

⁶ Control of Settlement by Humidity and Temperature *op cit*

publish wet bulb data but the usual dry bulb reading under these conditions is close to 53° F

Huntington⁷ by an entirely different method arrived at 60° F as the best temperature for strenuous physical work and 40° as the best for mental work. In a private letter he writes that this means 40° *outside* temperature. Brain workers then receive the maximum stimulus from the differences between indoors and outdoors.

As regards the upper limit of temperature suited for fairly close white settlement the chief regions where such conditions obtain are in Brazil and in North Queensland. An average annual temperature of a little over 70° F seems to characterize the outer fringe of fairly close white settlement. But even an average temperature of 68° involves several trying months for settlers in Australia of mid European race.

With regard to the lower limit, the chief control is economic rather than hygienic. The Polar boundary of agriculture is not far from the annual isotherm of 30° F. We may, therefore, adopt these temperatures (30° 53° and 70°) as critical values in our investigation.

Any world wide study of temperature is greatly handicapped by the fact that all published maps (so far as I am aware) show isotherms *reduced to sea-level*⁸. This may be essential for forecasting but it makes the map almost useless for the economic geographer. Obviously it is not much use to know that Tibet would have a temperature of 70° if it were at sea level when actually the thermometer is usually below freezing!

In Fig. 146 I give one of the first approximations to the *actual* average annual temperature chart of the world. It is based on Buchan's map of Bartholomew's *Meteorological Atlas*⁹ but is modified in accord with data in Hann's *Klimatologie*¹⁰ and elsewhere. The factor of 10° F decrease with each 3 000 feet elevation has been used in calculating the temperatures. Little alteration is necessary in Europe and Australia but Africa and especially Asia show striking convolutions in the isotherms.

The usual maps tend to give a wrong impression of inland Asia.

⁷In *Civilisation and Climate of the World*.

⁸While this was true in 1922 it is pleasant to record that many atlases now publish *actual* isotherms rather than the isotherms a country would have if it were cut down to sea level.

⁹London 1899.

¹⁰Stuttgart 1897.

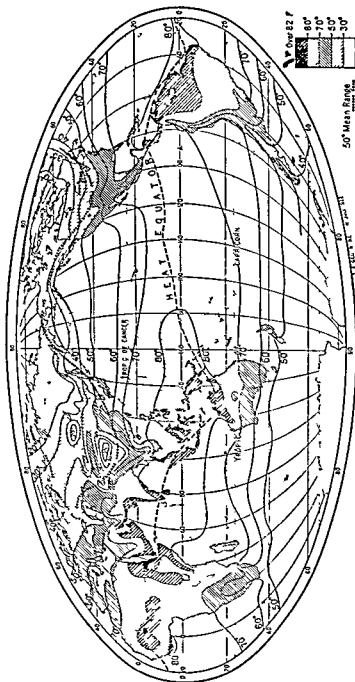


FIGURE 146—Actual average annual temperature (i.e., not reduced to sea level). The region of great annual range of temperature (over 50°) is enclosed within the dotted line. The heavy broken line shows the heat Equator passing through the four hottest recorded regions of the world 1, Timbuktu, 2 Massowah 3, Tinnaveili, 4 Wyndham 1 or January and July isotherms see Fig 148a

We see that vast areas are too cold to have any value as areas of close settlement. On the other hand there is a corresponding improvement in Africa especially in the Rhodesian region where a cool loop runs north nearly to the Equator. The same feature is shown in the west of South America.

An interesting feature is the course of the thermal Equator. It runs through Wyndham in West Australia, for this is one of the four hottest regions in the world and is far hotter than anything to the north or south of it.

APPROXIMATE LAND AREAS WITHIN GIVEN TEMPERATURE BELTS
(Unit: 1 000 square miles)

Values Temperature in degrees F	VIII Under 20	VI 20-30	IV 30-40	II 40-50	I 50-60	III 60-70	V 70-80	VII 80+	Total
Europe	0	160	800	1 790	760	320			3 830
Percentage		4.0	21.0	47.0	20.0	8.0			
As a	2 500	2 180	2 780	1 840	2 440	2 020	2 160	1 820	17 740
Percentage	14.0	12.2	15.6	10.4	13.8	11.5	12.0	10.0	
Africa					830	1 460	6 880	1 910	11 080
Percentage					7.5	13.0	62.0	17.0	
North and Central America	2 400	1 360	1 200	1 360	1 140	1 500	320	70	9 350
Percentage	25.1	14.6	13.4	14.6	12.2	16.0	3.4	1.0	
South America			170	340	470	1 460	3 300	1 420	7 160
Percentage			2.4	4.8	6.6	20.0	46.0	20.0	
Australia				40	240	1 180	1 140	300	2 960
Percentage				1.0	8.0	40.0	39.0	12.0	
Greenland	510								510
Antarctica	3 670								3 670
Total	9 080	3 700	4 950	5 370	5 880	7 940	13 800	5 580	56 300
Percentage	16.0	6.6	8.8	9.5	10.4	14.1	24.5	9.9	

In the preceding table the areas in the various continents experiencing specified temperatures are given.

The total areas by continents in the two most favourable temperature belts (40°-60°) are as follows:

1 Asia	4 280 000 square miles
2 Europe	2 550 000
3 North America	2 500 000

4	Africa	..	830,000	square miles	-
5	South America		810,000	" "	
6	Australia		280,000	" "	
7	Antarctica		nil		

The dominant position taken by Asia in Fig 146 and in the above order is to some extent paralleled in Huntington's world-map of "Human Energy on the Basis of Climate"¹¹ But however energetic a race may be, it has not much chance in the struggle for existence if natural resources are wanting. When agricultural and mineral resources are also considered, it is seen (see Fig 155) that the greater part of Asia has a poor future

Now that we have obtained a fairly accurate idea of the distribution of the temperature belts, it is necessary to estimate their effect on the density of white settlement. This can only be obtained empirically from data relating to the sole region where European settlement is fairly dense, i e., in Europe itself.

The densest populations in Europe are distributed along the coal-belt from Swansea to Silesia Here temperature is obviously not the main factor. Another obvious control (tending to prevent settlement) is elevation—though here temperature is concerned as well as absence of good soils and difficulty of communications. Hence, we shall find that the temperature effect is least complicated by other factors in the *lowland regions where no coal is present*.

In Fig. 147, I have charted the temperatures and densities of almost all the plains in Europe, from the south of Sweden and Central Russia (with an average temperature of 42° F.) to Andalusia and Algeria (which is also settled by European peoples) with a temperature of 63° F. These seventeen regions with one notable exception (Western France) lie fairly close to a cusped curve. It is to be noted that the rainfall (from 20 to 30 inches) is much the same in all these localities, except in Ireland and Portugal.

There are, of course, considerable differences in some of the minor controls. For instance, the scale of living—the facilities for communication—and the *annual range* of temperature are variable as well as the temperature itself. This, of course, complicates the problem. No doubt the high position of Italy is partly due to her low scale of living, while the low position of Western France is perhaps partly due to her poor soil and relative lack of harbours But, all

¹¹*Distribution of Civilisation* (New Haven, 1915).

I have found the data given in Finch and Baker's *Geography of the World's Agriculture*¹² of great assistance in drawing up the graphs given in Fig 147

The temperature controls for the main European and United States food crops are somewhat as follows

Barley grows in regions with an average annual temperature as low as 30° F Oats, wheat (in Canada), and potatoes are also possible in such countries if they have a relatively hot (continental) summer The *optima* for barley and Canadian wheat are near 40°, for oats and potatoes near 45°, for United States maize near 49°, and for European wheat 51°

These crops have little relative importance in regions above 60°, except the Indian wheats It is worth noting that Central Queensland, East Brazil, Yucatan, and Rhodesia are all regions where the climate would seem to be suitable for this winter wheat crop

It is obvious that the temperature belt from 35° to 60° is that most favourable to grain crops, proceeding from barley through Canadian wheat and oats to maize and European wheat However, the closest white agricultural settlement does not occur in these open prairie lands, but in the mixed farming country, where the optimum temperature is distinctly higher

The lower limit for stock is also about 30° F, where sheep occur Cattle are not much in evidence below 35°, while pigs and goats begin about 40° The *optima* are somewhat as follows (according to Finch and Baker's charts) pigs at 45°, cattle about 50°, goats at 56°, and sheep at 65° The cattle (excluding dairy cattle) range importantly through the tropics, but the other stock are not of much importance above 70° F

E Rainfall Control

If temperature is the most important control rainfall is easily the next most important, and if one were ignoring the race aspect, it would rise to the chief place among the physical controls of settlement

The lower limit of important settlement can be placed about 15 or 20 inches of rainfall per annum In certain favoured regions, where the rainy season is very reliable and where the rain falls just at the right time, it is possible to grow wheat successfully with a rainfall as low as 11 or 12 inches This is the case in a narrow strip of country in West Australia, in South Australia, and in the Mallee of Victoria

¹²Washington 1917

As regards the optimum rainfall for European settlement there is not much to choose anywhere from 40 to 50 inches. The lower rainfall is adequate in cooler regions the higher is not too much in regions where the evaporation is very rapid unless it is somewhat concentrated in the summer months when the wet bulb readings are too high for comfort (as in Brisbane)



FIGURE 148.—World map of rainfall variability (After Biel) (From Isaiah Bowman *The Pioneer Fringe* American Geographical Society New York) The major annual isohyets are indicated on Fig. 149

In the section on Australia (p. 371) the great importance of the regular recurrence of rainfall has been stressed. All over the world grain is grown to a considerable extent precisely in the regions where the rainfall is rather unreliable. Thus in Australia the variability is about 25 per cent where much wheat is grown. In Canada and the United States the Dust Bowl regions seem to be more favourable in this respect with variabilities around 20 per cent (Fig. 148). Among temperate lands the regions near Lakes Erie and Ontario are among the most favoured. In general aridity and variability agree as Biel's map clearly demonstrates.¹²

In South Eastern Australia near latitude 34° S there is a very uniform decrease in rainfall from 50 inches at the coast to 8 inches near Broken Hill. Dairy cattle are densest on the coast with the

¹²E. Biel *Geogr. Jahresbericht* (Vienna 1929)

maximum rainfall, while cattle are unimportant in the region below 12 inches. Sheep are a maximum about 32 inches but range from 42 inches downwards. Wheat is grown between 12 and 28 inches with a maximum at 22 inches. (The data for North American sheep and for spring and winter wheat are also indicated in the original paper on Future White Settlement)¹⁴

It is important to note that the great cattle and sheep regions are not those semi arid districts usually so designated in America and Australia but that by far the greater number are reared in the wetter regions where their importance is apt to be lost sight of among the many other occupations of the settlers. As regards the vast and expanses of Australia with a rainfall below 10 inches only a very small percentage (i.e. about 2 or 3 per cent) is grazed there and it will never bulk importantly among the pastoral regions of the world. Similar conditions obtain in the other arid regions of the world.

Few countries receive more than 60 inches of rain. In Australia this heavy precipitation is of little advantage either in Queensland or in Tasmania. In most countries it is a disadvantage and so I have classed it in the scale shown in Fig 153 as less valuable than a rainfall of 50 inches.

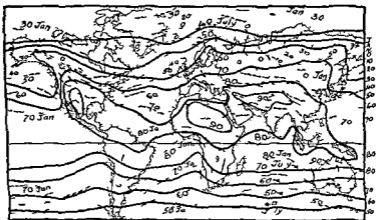


FIGURE 148a

¹⁴See note on p 424

CHAPTER XXXI

FUTURE SETTLEMENT AS CONTROLLED BY AGRICULTURE AND COAL SUPPLY

A World Agriculture

From the point of view of white settlement, there are four types of land surface which are quite unsuitable. These are the *tundras* of the Polar regions which are too cold for abundant animal life, and also usually too dry¹. Secondly, and most important, there are the *desert* regions of the world, which are too dry for agriculture, though a certain amount of stock can live therein. Thirdly, there are the rugged *mountainous* regions and cold plateaux. (In tropical regions the plateaux are much more favourable for settlement, but unfortunately they are not very extensive. Huntington, however, points out² that these tropical plateaux suffer from the excessive monotony of their climate. The healthy *variety* of temperate regions is absent.) Fourthly, there are the *hot, wet* regions of the tropics whose natural resources are abundant, but whose climate is quite unsuited for close white settlement or indeed for any white settlement requiring constant manual labour until "central cooling" is cheap and universal.

In Fig 149 these four types are given in a generalized form. Here the regions left blank are those suited for European settlement of some sort. Almost the whole of Europe and North America is available, and about half of Asia and Australia, and relatively small proportions of Africa and South America. It is the purpose of the later sections to give a quantitative estimate of the value of these regions.

In the moderately watered tropical regions, a considerable population of *pastoral* whites will probably develop. In my opinion, there is no prospect of a large agricultural settlement there. In temperate regions I have inserted the *optima*, i.e., the zones where the most important crops thrive. In the Northern Hemisphere the *optima*, like the chief mountain ranges, run for the most part from east to west. They are, however, broken by the arid and mountainous regions.

¹Sparse pastoral occupation based upon reindeer is possible as Stefansson has pointed out in several recent books (see p. 360)

²In *Civilisation and Climate* *op cit*

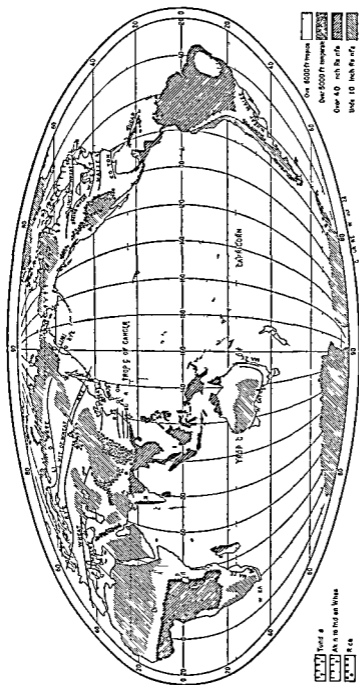


FIGURE 149—Map showing in generalized form regions suitable for white settlement and crop zones of the temperate lands. Shaded areas (ruled or circles) are largely unsuitable for white settlement.

In the Southern Hemisphere the trend lines of the continents run north and south. The crop belts more or less agree with this direction. In no case does the crop region extend to the desert areas, but a belt of stock country always occupies the marches of the desert.

The optimum of the wheat crop is near the optimum of white settlement in northern lands. In southern lands the present wheat optimum (in easily tilled prairies) is on the arid side of the optimum of white settlement.

Isopleths for rye, wheat, maize, cotton, tea, and sugar, and Indian wheat are inserted in Fig. 149, in a somewhat generalized fashion. They are in part derived from Finch and Baker's fine series of maps.³

B Coal Control

Coal has been described as the "mother of industry." There is no doubt that the great industrial settlements will remain where power is cheap for many generations. Hydro-electric power—the *blanche houille* of the French—is not likely to be a serious rival of coal except for certain specialized industries, for very many years.

In 1911 the Geological Congress at Ottawa arranged for a survey of the world's reserves of coal. I have used the ensuing invaluable volumes very freely in this section of the paper. In Fig. 150 a condensed statement of the results is charted.

The most striking feature of the map is the way in which all the major coal reserves are clustered in the Northern Hemisphere, north of latitude 34°. A teleologist would be inclined to believe that Providence had arranged the world's coal supplies with an eye to the dominance of the white settler.⁴ Probably this coincidence indicates that the climates during past ages have, on the whole, not varied very largely,⁴ and that the coal-forming vegetations grew under warm temperate conditions. Possibly our present world temperatures are rather lower than usual—for we are living in the later stages of the Pleistocene Ice Age.

The total coal reserve, so far as is known at present, is approximately $7,000 \times 10^9$ tons.

Of this colossal amount over 90 per cent occurs in the seven countries given on the next page. This table is based on figures given

³*Geography of the World's Agriculture* op cit

⁴Incidentally this apparent permanence of climatic regions is in opposition to Wegener's theory of drifting continents.

by the Dresdner Bank, 1927, where the tons of lignite are listed as converted into (fewer) tons of bituminous coal

	<i>tons</i>
United States	2 730 × 10 ⁹
Siberia	1 572 × 10 ⁹
China	990 × 10 ⁹
Germany	240 × 10 ⁹
United Kingdom	189 × 10 ⁹
Canada	150 × 10 ⁹
Australia	148 × 10 ⁹
	6 029 × 10 ⁹

The more one studies the resources of the world the more astounding is the position of the United States. It excels in temperature, in rainfall, in coal—so that the centre of the world's industry and of the

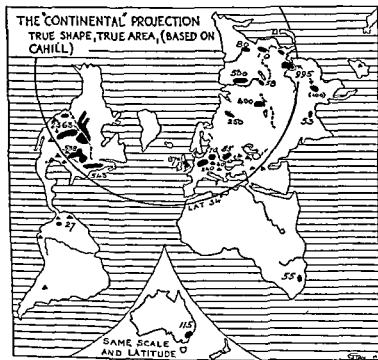


FIGURE 150—Estimated coal reserves of the world (in thousand million tons) showing about 50 per cent in North America, about 33 per cent in Asia and 12 per cent in Europe. Siberian figures are doubtful (Mainly from Dresdner Bank 1927). Chief petroleum fields in 1936 shown by black triangles. Open triangles are less important oilfields producing from 14 to 100 million barrels in 1936. Canada's total is 150 units.

white population will inevitably move across the Atlantic from Europe to North America

In the *Fortnightly Review* of February, 1918, "Politicus" discusses the effect of the coal factor somewhat as follows

Coal production and the birth rate are closely related, for only where there is cheap power can the densest civilized populations obtain remunerative wages in the many factories dependent on the coal. Hence the so called "decay of the French nation" is almost entirely due to her poverty in coal and iron, which largely depended on German aggression in 1871. Almost all the growth of German population has occurred in the coal and iron towns, whose expansion has only been exceeded by the western towns of the United States. On the other hand, the German rural population was less in 1910 than in 1871.

Similar results are to be expected in the other coal regions of the world, which makes the following table of vital interest in the question under discussion. In this table, I have discussed separately the several well-defined coalfields which occur in some of the countries listed.

It may be objected that we have no accurate knowledge of the geological formations through large areas of the world. This is no doubt true of much of the tropical forest country in Brazil and Africa, but here, as we have seen, white settlement is not likely to take place owing to climatic disabilities.

I have not thought it necessary to consider other mineral deposits in this world wide survey. Iron ore is generally carried to the coal fields. Gold and other deposits do not lead to settlement to the same extent that coal does. In Australia it has been estimated that only about 120 000 people dwell in goldfields which are remote from agricultural districts.

It is true that the gold discoveries of 1851 led to a large influx of immigrants, as has often been pointed out. But very few of these immigrants ultimately engaged in gold mining; they turned to farming, etc. In other words the gold merely accelerated a settlement which would inevitably have occurred without this attraction, though at a much later date.

C *Progress in Siberia*

In Siberia however, the energy of the Socialist régime has led to a vast increase in geological research. As a result, the coalfields of the Soviet Union rank second only to those of the United States, as

RESERVES ON THE CHIEF COALFIELDS OF THE WORLD

(Based on the Reports of the Geological Congress of 1911 except Siberia)

No	Locality	Tons × 10 ⁶	Kind of coal	Remarks
1	United States Northern Plains	1 175 000	Largely lignite	Black Hills and Colorado are bituminous
2	Canada Alberta‡	1 000 000	Lignite or soft coal	Bituminous in centre anthracite along west
3	United States Rockies	1 000 000	{ Bituminous Anthracite	In Montana In Utah etc
4	China Shansi	714 340	Anthracite	Possibly best in world
5	United States Eastern	500 000	Anthracite	Chiefly Pennsylvania Ohio W Virginia
6	United States Central	500 000	Anthracite	Chiefly Illinois and Missouri
7	Tungus N Sberia*	500 000	—	
8	Kuznetzk S Siberia*	400 000	—	
9	Petchora N Russia*	250 000	—	
10	Germany Westphalia	212 000	Bituminous	
11	South west Poland	166 000	Bituminous	
12	China Yunnan etc	140 000	Anthracite and bitu- minous	Also Hunan and Szech- wan
13	England (total)	125 000	Bituminous	Carboniferous
14	New South Wales‡	115 000	Bituminous	Permo-Carboniferous
15	Bureya E Siberia	110 000	—	
16	Canada British Columbia	70 000	Chiefly bituminous	Crow s Nest
17	Canada Saskatche- wan	57 400	Lignite largely	Cretaceous etc
18	Transvaal	56 200	Chiefly bituminous	
19	Russia Donetz	55 000	Chiefly anthracite	
20	India Raniganj	53 000	Bituminous	
21	Wales	40 000	Bituminous anthracite	
22	Bohemia	40 000	Bituminous anthracite	Pilsen and Prague
23	Victoria Morwell	30 000	Brown coal	Tertiary
24	Colombia	27 000	Bituminous	
25	India Hyderabad	23 000	Bituminous	
26	Scotland	22 000	Bituminous	
27	United States Texas	21 000	Lignite	
28	Indo-China	20 000	—	
29	Germany Saar	16 000	—	
30	Belgium	11 000	Bituminous	
31	France	11 000	Chiefly bituminous	

*Siberian data from *Handbook of Soviet Union* 1936

‡Much reduced in later estimates (p 413)

the list on page 441 shows. This has altered the writer's views on the future population of Siberia considerably.

The coalfields are shown on Fig 150, while the agricultural possibilities are charted on Fig 151. Of particular interest to Canadians are their experiments in reclaiming the peaty soils of the colder areas, which are much like the Canadian *muskeg*. By the use of phosphates from Kola Peninsula, and by the drainage of the lower levels, large areas of what were formerly waste-lands have already been made arable.

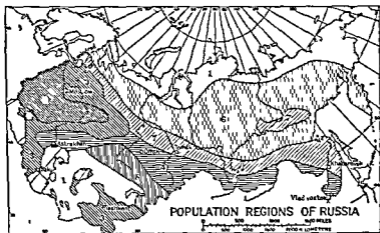


FIGURE 151—Population regions of Russia. 1, areas not suited to agriculture (tundra and desert), 2, areas with rural over population, 3, fully occupied areas with no excess of population, 4, relatively densely populated areas with possibilities for additional settlement, 5, «parsely populated areas, 6, part of the taiga belt unsuited to agriculture, 7, southern border of the taiga belt suited to agriculture. (From Isaiah Bowman, *The Pioneer Fringe*, American Geographical Society, New York.)

The richest section is the *Chernozem* (Black soil) which covers about 400,000 square miles. This belt extends south of a line drawn from Moscow to Omsk (Fig 151), and is about 200 miles wide. Hence most of the regions labelled 2 and 5 (together with the intervening strip) in Fig 151 are Chernozem.³

There are vast possibilities of industrial development in Siberia. In the west the iron from Magnitogorsk in the Urals is being smelted with the coal of Kuznetsk, 1,000 miles to the east. On the Angara River below Lake Baikal, they are developing what may be the cheapest hydro-electric power in the world. On the Bureya River

³This section is based on the valuable account by Bruce Hopper in *Limits of Land Settlement* (Report to the Tenth International Studies Conference, Paris 1937).

in the Amur Basin vast bodies of coal and iron are close together, so that an important industrial region is certain to develop here

The birth rate of the Russians is very high, so that the population is expected to double itself in the next forty years. The forecast of 340 millions of Soviet citizens by 1975 is quite likely to be realized.⁴ According to O-sinsky, six million Russians entered Siberia between 1800 and 1915 of whom 1 312 000 were exiles. There are over 20 millions now. Millions of the citizens of the future can be settled in the belts numbered 5 and 7 in the map (Fig 151). Indeed one feature of the last few years has been the rapid growth of a number of towns in West Siberia, as the following table shows. (See also p 171.)

GROWTH OF SIBERIAN TOWNS NEAR TOMSK

	1926	1933
Novo-sibirsk	120 382	310 000
Keremovo	21,500	124 000
Prokopyevsk	10 000	121 000
Stalinsk	3 900	220 000

D Location Factor

We have considered the three major factors determining close European settlement. Of the remaining, soil and communications are perhaps the chief. Both of these depend largely on the elevation—for almost all the largest areas of good soil and of easy communication (i.e., the Chernozem of Russia, the Ganges and Chinese regions) are plains below 2,000 feet elevation. It will be useful to consider the chief elevated regions with a considerable population.

In Europe the largest areas of heavy population occur in the Rhine and Po Valleys below 600 feet, and along the slopes of the Bohemian Highlands, etc., at about 1,500 feet. Only in Spain and Bulgaria are there many inhabitants above 3,000 feet.

In Asia the regions of close settlement in India are below 1 500 feet and in China below 3 000 feet. In Mysore, Western Persia, Yunnan, and Southern Tibet there are elevated regions with moderate settlements.

In America the chief population is below 1,500 feet, but Mexico, Colorado, and the Andean Plateaux offer notable examples of high level populations. Speaking generally, elevation is a disadvantage for it always implies heavy transport difficulties. Tropical plateaux are an improvement on tropical lowlands for white settlers inasmuch

⁴The enormous casualties of the present war will inevitably retard the growth of the Soviet population.

as they come nearer to the optimum temperature, but this is expressed by the temperature scale in our estimate of the value of the region under consideration. Good soils, generally due to extensive deposits of river silt, are, as stated previously, generally found in the lowlands. We can therefore, use a *location scale* ranging upwards from an optimum at *sea level*, and trust to the temperature control to express the healthier conditions of tropical plateaux.

E Highlands in Africa

In the original edition of this book (1927), little attention was given to the prospects of future white settlement in Africa except in the south. Indeed, apart from South Africa and Ethiopia, they are not likely to bulk large in the white populations of the future. In Algeria there are about 800,000 French and Italian settlers. It is stated that 500,000 may find room in the newly pacified lands of Morocco.⁷

In Fig 152 the highland areas, which have an average temperature below 72° F *in the hottest month*, are left blank. Ethiopia is seen to offer the largest area suitable for white settlement within the tropics. The similarity of the region to Mexico is striking. Cotton, coffee, maize, and bananas can be grown at lower levels, while wheat, barley, and oats will thrive in the higher districts. Here snow lies on the grounds for months at a time.

Passarge has stated that the volcanic soils, abundance of water, and healthful climate may support a population of as much as 30 million white farmers.⁸ This seems to the writer entirely too optimistic a view.

We may use Ethiopia to test the forecasting methods. The area of highlands is of the order of 180,000 square miles. Assuming that half of this can be used for farm land, a very big assumption, and assuming further that an average farm would be 64 acres (rather small compared with the 400 acres in pioneer Canada), we find that there might be room for about 900,000 farms. To reach Passarge's figure of 30 millions, we have to assume that each farm supports 32 people. This leaves little room for the unfortunate Ethiopians.

If we use the econograph method, then the index of habitability would be about 200, for such a region as Ethiopia. This is about equal to 50 per square mile (see p 459). Using the area quoted above, we find that the possible population comes out about 9 millions. To the writer this seems a much more likely figure. This estimate is

⁷J. H. Wellington in *Limits of Land Settlement*

⁸*Geographic Review* New York Jan 1936 p 153

based on a European standard of living. Many more could live there on a bare subsistence standard. But since there are twelve million Ethiopians already, there does not appear to be room for many million Europeans whatever way we make our estimate.

The tsetse fly, which conveys diseases that kill man and his domestic animals, is a terrible enemy throughout all Equatorial Africa, except in the higher parts of Kenya and Tanganyika. The two main areas of tsetse are enclosed in the broken lines in Fig 152. West of Lake Victoria about a hundred Belgian settlers are struggling against this pest.*

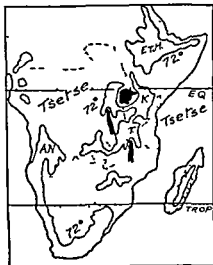


FIGURE 152—Potential areas of white settlement in tropical Africa. Cool regions (below 72° for the average of the hottest month) are left blank. Broken lines enclose the two tsetse-fly regions. Lakes are black.

Kenya has about 16,000 white settlers in the "European Highlands" and there are about 7,000 in Tanganyika to the south. Angola has 40,000 Europeans, partly engaged in grazing and in growing maize and sisal. Here also the tsetse is a menace to stock. Thus Africa's Highlands do not seem likely to add much to white population in the near future.

F Secondary Controlling Factors

It will be found that almost all the factors influencing human settlement are based on the four now considered. Health is controlled

*J. H. Wellington *op cit*

primarily by temperature and humidity, of which the latter is closely related to rainfall. *Agriculture* is concerned with rainfall and temperature. A rich *soil* is not vital, for in the Australian Mallee and other regions of an extremely sandy nature an addition of superphosphate gives a payable wheat yield. In the future, artificial manures will be of increasing importance, but the natural controls of temperature and rainfall can never be altered.

Irrigated regions are perforce not properly represented in this scheme. Except for Egypt and Mesopotamia, they are not likely to build up vast populations in desert countries. In Australia, for instance the irrigated lands form only one part in ten thousand of those which require more rainfall, and this small proportion will never be sufficiently increased to be of much importance.

The *Pastoral industries* are determined almost wholly by rainfall and not by temperature, for some varieties or other of cattle, sheep, or allied animals range throughout the continents excluding only the permanent ice caps and the dense tropical forests. *Industrial settlement*, the great feature of modern life, is dependent essentially on temperature and coal. We have noted that there are no coalfields or hydro-electric sites in arid regions.

It is impossible to discuss every factor. *Fisheries* are ignored, and they lead to some fairly important populations. *Oil* supply is a vital factor, and it produces about 17 per cent of the world's power, coal giving 74 per cent and waterfalls 9 per cent (Fig 150). But so much of it (70 per cent) comes from the United States and Baku, that it is not likely to lead to many new industrial regions.

CHIEF OILFIELDS 1936

Production in million barrels

<i>United States</i>		<i>Rest of World</i>	
Texas	424	Baku U.S.S.R.	150
California	214	Venezuela	148
Oklahoma	201	Rumania	62
Louisiana	60	Iran (Persia)	57
New Mexico	26	Borneo	51
Pennsylvania	17	Mexico	40
Wyoming	14	Irak (Mesopotamia)	28
Michigan	11	Grozny U.S.S.R.	23
		Colombia	17

The psychical factor, for instance the influence of religion and of education in determining man's environments and status is obviously an aspect which does not lend itself to quantitative representation.

CHAPTER XXXII

FUTURE WHITE SETTLEMENT DEDUCED GRAPHICALLY
BY THE "ECONOGRAPH" METHOD

The most difficult feature in this research was to compare the values of the four major factors with regard to each other. What is the order of importance as a control of European settlement among the factors, temperature, rainfall, coal, and location? I was only able to arrive at what seems a fairly satisfactory conclusion by a method of trial and error.

I have shown that temperature is the most important factor. No matter what the variations in rainfall or location, there are no important "white" regions with annual temperatures below 30° or above 70°. After trying the effect of giving the *same* "weights" to temperature and rainfall, and then a ratio of 3 to 2, I found that 2 to 1 gave results as concordant as could be expected; i. e., the resultant economic graphs for certain fully developed regions agreed fairly with their respective populations. Hence I was led finally to giving temperature double the value of rainfall as a determining factor.

Location, on the other hand, was of much less importance. As long as the regions were on the average below 1,500 feet or so, this factor was not vital. Above that elevation a handicap was introduced. I assigned to the location scale one-half the importance of rainfall, and one-quarter the value of temperature (Fig 153).

With regard to coal, it was only possible to see how this factor influenced the population of a country by comparing it with an adjoining country not blessed with this asset.

DENSITY OF POPULATIONS

<i>Country rich in coal</i>		<i>Small or no coal supply</i>		<i>Ratio</i>
Bohemia	315	Hungary	160	1 9
Germany	324	France	191	1 7
Poland .	193	West Russia*	94	2 0
Britain .	460	Ireland	140	3 2

*Four adjacent provinces equal in area to Poland.

The above comparisons are by no means exhaustive, and some striking exceptions (such as Italy) can be found; but they serve to

The ideal region would have an econograph like that shown in Fig 153. The temperature would be 55°F , the rainfall 50 inches, the region would be at sea level and the coal supply 200×10^4 tons per square mile. It will be seen that the temperature and rainfall give the triangle ABO (in Fig 153), while the presence of a coal supply as large as the figures just quoted doubles this, by adding the triangle AOD . The location effect is shown by the small area below the line BD . It is not of much importance save that, if a region be mountainous, this area almost disappears.

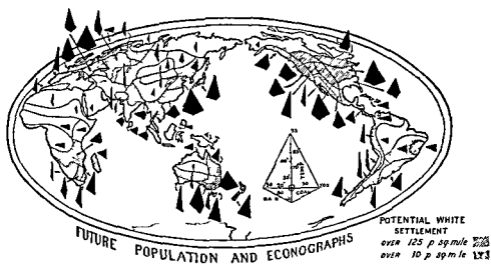


FIGURE 154—Econographs for the seventy four regions. The larger the econograph the greater the habitability. The large inset graph shows the arrangement of the four axes.

In the scale used, the area of the ideal econograph occupied exactly 1,000 units. All the seventy four regions were below this ideal, though Britain and North China each totalled 770 units. As Fig 153 shows, the econographs for Norway and tundra were 60 units and 27 units respectively. It is my purpose to show that the area of the econograph represents the habitability of the region as closely as one can expect to assess it in the present state of our knowledge.

In the lengthy table on pages 452, 453 I have recorded the economic factors. The first column gives the area of the region. The columns A, B, C, and D are plotted to form the econograph according to the scales on the ideal graph (Fig 153).

ECONOMIC FACTORS OF THE REGIONS

<i>Region</i> (see Fig 154)	<i>Area</i> (square miles × 10 ³)	<i>Average</i> <i>annual</i> <i>temp</i> (°F)	<i>Annual</i> <i>rainfall</i> (inches)	<i>Average</i> <i>eleva</i> <i>tion</i> (feet)	<i>Total</i> <i>coal</i> (tons × 10 ³)	<i>Coal per</i> <i>sq mile</i> (tons × 10 ⁴)	<i>Area of</i> <i>econo</i> <i>graph</i>
<i>Europe</i>		<i>A</i>	<i>B</i>	<i>C</i>		<i>D</i>	
British Isles	120	50	40	600	190	160	770
Franco Prussia	422	50	30	600	250	60	620
Poland (with south west Russia etc)	400	50	28	600	166	50	565
Central Russia	1 200	45*	20	600	55	4	245
Mediterranean	545	60	20	1 500			210
Northern Russia	461	38	15	600			65
Norway	125	28	38	3 000			60
Tundra	600	29*	9	600			12
<i>Asia</i>							
Northern China	360	55*	30	1 500	714	200	770
Japan	300	55	40	2 000			484
Southern China	588	68	65	2 000	140	24	288
Mediterranean	158	60	18	3 000			180
Sam	750	75	60	1 000	20	3	136
Manchuria	940	30*	20	1 500			120
Western Siberia	768	35*	15	600	700	110	200
Ceylon	25	80	30	1 500			78
Deccan	588	75	20	1 200			72
Persia	1 000	55	10	3 000			66
Eastern Siberia	740	30*	12	2 000	400	53	100
East Indies	800	80	80	2 000			43
Aral	1 100	50*	6	600			40
Altai	820	20*	15	4 500			35
Tibet	2 100	30*	12	12 000			30
Tundra	3 220	20*	10	600			27
Arabia	1 372	75	10	1 500			20
Tarim	750	55*	6	3 000			20
Thar	263	80	5	600			13
Northern India	870	75	40	1 000	78	9	140
<i>Australasia</i>							
Victoria	172	55	30	1 000	30	18	575
Eastern coast	98	65	40	2 000	115	110	574
New Zealand	101	50	50	2 000			430
Tasmania	26	50	40	1 200			400
Swanland	172	60	20	1 000			225
Queensland	282	73	25	1 000			143
Lachlan	245	65	15	500			119
Northern coast	578	80	25	800			70
Southern arid	835	65	7	1 200			40
New Guinea	343	77	100	2 000			21
Northern arid	565	75	9	1 000			16

ECONOMIC FACTORS OF THE REGIONS (continued)

Region (see Fig 154)	Area (square miles × 10 ³)	Average annual temp (°F)	Annual rainfall (inches)	Average eleva- tion (feet)	Total coal (tons × 10 ³)	Coal per sq mile (tons × 10 ⁴)	Area of econo- graph
<i>Africa</i>							
Natal	140	60	30	3,000			300
Transvaal	264	62	20	3 000	56	21	273
Cape	128	59	20	1,500			225
Ethiopian Plateau	180	72	30	5 000			200
Rhodesia	1,250	72	40	3,000			180
Madagascar	227	72	40	1,500			136
Algeria	390	68	20	2,000			125
Congo	1,587	78	70	1,000			76
Uganda	770	75	30	3 000			68
Sudan	2,080	70	35	1,500			65
Kalahari	500	63	8	3 000			48
Northern Sahara	2,466	68	1	1,000			16
Southern Sahara	1,338	78	5	1,000			10
<i>North America</i>							
North Eastern States	747	50	35	1,000	1,000	135	755
Inland plains	592	60	20	2 300	1,175	200	675
Alberta	630	40*	15	2,500	150	25	420
Utah	250	45	10	5 000	500	200	345
South Eastern States	486	65	40	1,000	21	4	326
Eastern Canada	960	40*	27	1,000			315
Oregon	246	55	25	3,000			315
Southern Rockies	510	65	12	5,000	500	100	300
British Columbia	345	38	40	2 500	70	20	286
Central America	592	70	60	3 000			165
West Indies	100	78	50	1,000			120
Southern California	444	63	10	2,000			72
Tundra	1,910	15*	12	1,000			15
<i>South America</i>							
Uruguay	750	65	35	1,000			315
Southern Chile	131	45	70	3 000			272
Western Argentina	525	60	20	800			210
Central Chile	78	55	15	3,000			184
Andean Plateau	525	63	15	8 000			112
Colombia	945	78	40	1 000	27	3	95
Central Brazil	1 820	78	70	1 000			91
Eastern Brazil	328	75	25	1,000			78
Amazons	1,969	80	80	500			65
Northern Chile	210	60	3	5 000			60
Patagonia	78	45	10	1 200			45

*Temperate region with hot (continental) summer 5° F added on econo-
graph axis

We may profitably study how the shape of the econograph varies, and the meaning of these variations (see Fig 154). A symmetrical graph (like that of Britain) indicates that a region is well equipped for agricultural or industrial occupations. If only the left side is present, it is chiefly an agricultural or pastoral region (e.g., Central Russia). In a few cases the right side predominates (as in Utah) which means that the coal reserves are likely to be of greater value than the agricultural resources. Where the lower triangle (below the horizontal axis) is large, the region possesses extensive lowlands, and is likely to have large areas suited for intense cultivation (e.g., Southern Russia). Where it is small, the country is elevated and usually not well suited for agriculture (e.g., Norway, Fig 153).

Somewhat similar indications are given by the length of the diagonals (or axes) (see Fig 154). If the upper axis is long, then the region will have a *comfortable climate* (e.g., Britain or Southern California), and if it is short the converse is the case (e.g., Norway or most tropical regions). A short axis to the left is unfavourable for white farming but is often suitable for a *pastoral* occupation. A wet mountainous region, where *hydro-electric* energy is usually plentiful, is shown by a short lower axis combined with a long axis to the left (e.g., Norway). The *desert* regions have a characteristic elongated shape ranging from the moderately arid type, such as Southern California to the almost entirely useless types of the tundra or the Thar (Fig 153). Owing to the recent discoveries of coal the Siberian econographs should be about twice as large as those shown on Fig 154.

CHAPTER XXXIII

POTENTIAL REGIONS OF WHITE SETTLEMENT

A World Isoketes

It will be admitted, I trust, that the *areas* of these econographs—all drawn according to the same scale, and embodying the variations in the major factors determining settlement—express approximately

REGIONS OF POTENTIAL CLOSE WHITE SETTLEMENT

Class	Group	Units of habitability 1,000 = max	Region as defined in Fig 154	Present settlement
I	a 1	770	Britain	Closely settled
	a 2	620	Franco-Prussia	" "
	b 1	770	North China	Not available for whites
	c 1	756	North-east of United States	Moderately settled
	c 2	675	Inland plains	" "
II	a 3	565	Poland, Austria etc	Closely settled
	d 1	575	Victoria (Australia)	Moderately settled
	d 2	565	East coast "	" "
III	b 2	484	Japan	Not available for whites
	d 3	430	New Zealand (and Tasmania)	Sparsely settled
	c 3	420	Alberta	" "
IV	e 1	315	Uruguay, etc	Moderate settlement
	f 1	300	Natal	"
				(not wholly available)
	c 4	345	Utah, etc (U S A)	Dry—sparsely settled
	c 5	326	South-east states of U S A	Moderately settled
	c 6	315	East Canada	Sparsely settled
	c 7	315	Oregon	" "
	c 8	300	South Rockies	Dry—sparsely settled
V	c 9	286	British Columbia	Sparsely settled
	b 3	288	South China	Not available for whites
	e 2	250	South Chili	Sparse
	a 4	245	Russia (central)	Fairly close settlement
	d 4	225	Swanland (Australia)	Sparsely settled
	f 2	213	Transvaal	" "
	e 3	210	West Argentina	" "
	a 5	210	Mediterranean	Closely settled

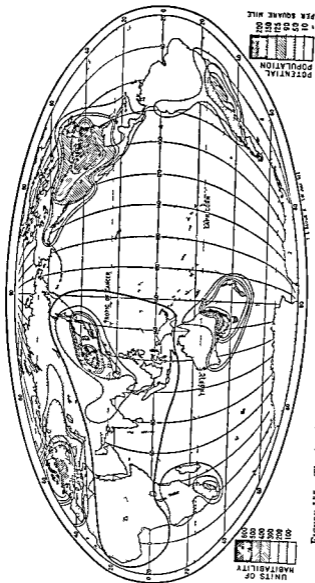


FIGURE 155—The distribution of future white settlement according to the economic value of the world regions. The area within the heavy black line is not available for white settlement, but has been treated uniformly here. The facts of the distribution shown in this figure may be expressed by degrees of habitability, shown by isoketes, (see legend to left) where the optimum of habitability is 1,000, or by the corresponding potential population density (see legend to right). The coloured peoples will certainly expand beyond Asia, but this aspect is not discussed here.

the habitability of the region charted. If now we plot the numbers expressing these areas on a map of the world (as in Fig 155), we can draw lines through the same numbers and form a sort of contour map. To such a line I gave (in 1917) the name *is oiketē*, from the Greek word *oiketos*, habitable.

In the preceding table the group letters refer to the six future world-centres. Thus *a* is London, *b* is Shanghai, *c* is Chicago, *d* is Sydney, *e* is Buenos Ayres, *f* is Durban. A seventh may develop in Siberia near Kuznetsk. Calcutta, like Shanghai, is not a centre of future white settlement.

Fig 155 drawn in this fashion, presents many points of interest. There are two first-class centres of (white) habitability, i.e., *a* and *c*, one of the second class (*d*), and two of the fourth class (*e* and *f*). These are shown in the preceding table.

The first eight regions in the above table are all endowed with a plentiful coal supply. In the third class come two regions, Japan and New Zealand, with poor coal supplies but excellent climatic controls. The enormous coal supply of Alberta is balanced by its long winter, so that it appears rather low down amid the most attractive regions.

REGIONS OF POTENTIAL MODERATE WHITE SETTLEMENT

Class	Units of habitability	Region as defined in Fig 154	Remarks
VI	200	Western Siberia	Sparsely settled
	200	Ethiopia	Largely occupied
	180	Rhodesia	Sparsely settled
	180	Anatolia (Asia)	Largely occupied
	168	Middle Chile	'
	160	Central America	'
	143	Central Queensland	Sparsely settled
	140	North India	Not available
	136	Siam	'
	136	Madagascar	'
	120	Algeria	Largely occupied
	120	West Indies	'
	120	Manchuria	Not available
	119	Lachlan Darling Basin (Aus)	Sparsely settled
112	Andean Plateau	Largely occupied	
100	East Siberia	Sparsely settled	

In this class Rhodesia, Central Queensland, West Siberia, and the Darling Basin offer large areas for settlement, which may be used as ranches or (in places) for farming.

The remaining regions of the world comprise the tundras, deserts, and hot, wet countries where even moderate white settlement is unlikely. A considerable development of the pastoral industry with sparse white settlement is, of course, probable in the more favourable areas

B Europe as a Criterion

The only large region where white settlement has taken place for centuries is, of course, the continent of Europe. From all the Euro-

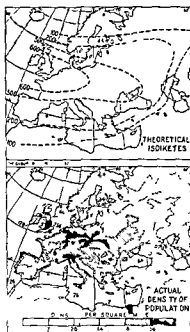


FIGURE 156—The actual population density of Europe compared with the theoretical isoketes (lines of 'habitability'), deduced from the econographs

pean countries emigration is removing the surplus populations, and though we cannot describe the continent as "saturated," it is the only one which approaches that condition

In Fig 156 the present distribution of population is given. It is based on Bartholomew's map in his most useful *Advanced Atlas*. We see at once that there is a strong resemblance between the *isoketes*

and the population lines. Thus both the population lines and isoiketes centre about London. They both form concentric loops about an axis reaching from London to West Siberia. The 100 isoikete agrees quite closely with the 10 population line, if the latter be inserted between the 2 and 26 lines. In the same way, the 200 isoikete agrees fairly with the 50 population line, if it be inserted. The 500 isoikete is near the 150 population line, and the 600 isoikete is not far from the 200 (except in Galicia).

Plotting on a graph the European density of population and its corresponding isoikete, we can interpolate for the regions of moderate habitability, which do not occur in Europe. We thus arrive at the following table

APPROXIMATE DENSITY VALUES FOR ECONOGRAPH AREAS

<i>Econograph area</i>	<i>Population density per square mile</i>
600 units	200
500 "	150
400 "	125
300	90
200	50
100 "	10

Using these factors, we can arrive at a probable answer to the question: How will the white population¹ of the world be distributed when the empty continents are occupied to the extent that Europe is at present?

C Distribution of Future Population

Using the ratios indicated in Fig. 154, we may hazard an estimate of the populations which will cluster around the five world centres of the Central United States, London, Sydney, Buenos Ayres, and Durban. When the surrounding regions shall have reached the condition of Western Europe (with a density exceeding 100 per square mile) we may expect populations of the following order

¹The probable expansion of the Asiatic peoples is beyond the scope of this discussion.

POTENTIAL POPULATIONS

Centre	Region as in Fig 154	Area in square miles	Estimated density per square mile	Total population
I North America	North-eastern states	670 × 10 ³	400	Millions 270
	Inland plains	592	200	118
	Alberta	630	40	20
	Utah	250	100	25
	South-eastern states	486	100	48
	Eastern Canada*	320	100	32
	Oregon	246	100	24
	Adjoining regions	—	below 100	30
				610
II Western Europe	Britain	120 × 10 ³	500	60
	Franco-Prussia	422	300	126
	Poland etc	400	200	80
	Adjoining regions	—	below 100	120
				386
III Argentina etc	Uruguay etc	750 × 10 ³	100	75
	Adjoining regions	—	below 100	40
				115
IV South Africa	Natal	140 × 10 ³	100	14
	Rhodesia	1 250 × 10 ³	(40)	50
	Adjoining regions	—	below 100	18†
				82
V South East Australia	Victoria	172 × 10 ³	180	29
	Eastern	97 × 10 ³	180	18
	Adjoining regions	—	below 100	15
				62

*Omitting much of the Shield

†f = foreign

In the above list I have omitted those regions which are classed as tundra, deserts, etc., in this paper. Europe comes out about its present population which indicates that the standards are as near as we can expect. An unexpected feature is the high value of Rhodesia

and Angola. The temperature, though high, is much superior to that of most other countries of the same latitude, owing to its high elevation. The rainfall is almost wholly a summer one, which is a disadvantage. (A somewhat analogous region is to be found in the Atherton Table land (2 000 feet) in Queensland, where settlement is going ahead rapidly.) "It is owing to the elevation of this great upland that the white man can live and work in comfort in Rhodesia, and that his wife and children may flourish by his side—conditions such as are rarely possible in other regions which come under our survey in these pages" ² (See, however, p 438)

If the estimates in the above table be accepted, the future white population of European ancestry (*using the present saturation level of Europe as a criterion*)³ will be distributed somewhat as follows

FUTURE WHITE SETTLEMENT AND ITS POLITICAL CONTROL

	<i>British</i>	<i>United States</i>	<i>Other states</i>	<i>Total</i>
	Millions	Millions	Millions	Millions
I North American region 52 per cent of total	100	500	10	610
II European region 29 per cent of total	60	—	440	500
III Argentine region 8.5 per cent of total	—	—	115	115
IV Siberian region	—	—	100	100
V South African region 6 per cent of total	76	—	6	82
VI Australian region 4.5 per cent of total	62	—	—	62
Total	298	500	671	1,469
Percentage	20	34	46	100

D Estimates of Future Total World population

Students of world population should read the papers by Warren D Smith and A B Wolfe, which summarize recent work on this

²C R Enock, *The Tropics* (London, 1915)

³The writer is gratified when he finds his tentative forecasts quoted. But usually this qualifying condition is omitted in such quotations! For example in the interesting pamphlet *The Growth of Australian Population* by F W Eggleston and G Packer (Melbourne, 1937)

problem as well as the books also listed in the footnote⁴ Two years after the writer's paper appeared, the famous German geographer, A Penck attempted to find the *total* future world population He made use of Koeppen's major climatic regions, which divide the world into eleven sections To the writer this seems far too few, considering the great variation in environment and, as will have been perceived, the latter used 74 natural regions for his estimate

In a recent paper Carr Saunders places the present world population at about 2 024 millions and Penck's estimate gives us a possible figure for the future of 7,670 millions In Warren Smith's discussion of Penck, he prefers a figure of 5 666 millions

PENCK'S ESTIMATE OF FUTURE POPULATION

<i>Class</i>	<i>Criterion</i>	<i>Density</i>	<i>Population in millions</i>
Tropical Rain Forest	Java	500	2 800
Tropical Savana	Madras	225	1 413
Deserts	Sahara	0 25	18
Steppes	Don (U S S R)	12	106
Mo st Temperate wet winter	China	250	930
dry winter	Bengal	228	1 243
Dry Temperate	California	250	225
Cool Temperate wet winter	North East Siberia	75	200
dry winter	Canada	49	735
Tundra			negligible
Ice cap			
TOTAL			7 670

Some of Penck's average figures for the density seem excessively high to the writer For instance, 49 for lands like Canada, for which 4 per square mile would seem high enough It is quite certain that the forests of the tropics are not as fertile as Java, hence the figure of 2 800 millions seems quite illusory However, this forecast, like that

⁴Warren D Smith World Population (*Scientific Monthly* Jan 1935) A B Wolfe 'The Population Problem since the War' (*American Journal of Political Economy* vols XXXVI VII 1928-9) W S Thompson *Population Problems* (New York 1935) E M East *Mankind at the Crossroads* (New York 1923) A M Carr-Saunders *The Population Problem* (Oxford 1922) A Penck Haupt problem der Anthropo-geographie (*Zeitschrift für Geopolitik* 1925)

of the writer's, is a pioneer study, and their chief value is in obtaining relative values (rather than absolute figures) for the populations of the regions considered

E Conurbations

Assuming that an adequate food supply is forthcoming, we may briefly consider how these vast populations will settle in the six areas specified in the table on page 461

Professor Geddes in his *Cities in Evolution*⁵ has pointed out that in the British industrial regions the cities at present merge into great "disorderly conglomerations" He looks forward to a time when orderly design shall control the growth of these clusters of cities or "conurbations" In England, for instance, there are already two great clusters, "Greater London" and what he terms "Lancaston" The latter, extending from Liverpool to Leeds, is already 100 miles wide He points out that five other conurbations are arising These are the Scottish centre (Glasgow Edinburgh), the Newcastle centre, the Sheffield centre, the Birmingham centre, and the South Wales centre

Lille and Essen are two continental examples which in the far future may unite *via* Antwerp and Liège Chicago in the United States, with its satellites Gary and Hammond, is a forecast of the intense settlement which will arise in the eastern states Even in Australia the rise of such towns as Cessnock (4 000) within the last few years points to a conurbation around Newcastle This may unite with Sydney and spread down the coast to the great Bulli coalfield

F Food Supply

Where is the food coming from to feed these industrial centres? Most people know of the huge granaries of Russia, the United States, India, etc., but fail to realize that already their huge populations permit of practically no export Canada, Argentina, and Australia are exporting considerable percentages at present, but how long can this be maintained in the face of their own augmented populations?

It has been estimated that before the war the United Kingdom and Belgium produced only 53 per cent and 57 per cent of their respective food requirements To a less degree Germany and even France were dependent on outside sources The closely settled regions of the

⁵London 1915

CHIEF WHEAT EXPORTING COUNTRIES AVERAGE PRODUCTION
AND EXPORT 1911³, 1923 AND 1933

(In millions of bushels)

	Millions of population			Production			Export		
	1911	1921	1931	1911	1923	1934	1911	1923	1933
Russia	133 [†]	158 [†]	162	727	330	797	128	none	74
United States	91	106	124	703	785	860	118	208	21
Canada	6	9	10	229	474	408	111	358	170
Argentina	7	9	12	156	247	241	101	193	140
India	247 [†]	300	356	370	—	349	60	38	—
Rumania	7	17 [†]	18	88	101	77	54	7	—
Australia	4	6	7	89	125	137	52	80	60

³G B Roorbach *The World's Food Supply* (*Annals of the American Academy of Political and Social Science* Philadelphia vol LXXIV 1917, pp 133) See also J Russell Smith *The World's Food Resources* (New York 1919)

[†]With Poland and the Ukraine

[‡]Including former Hungarian lands

East—India, China, and Japan—are also greatly concerned with these problems

Professor Russell Smith makes the following remarks which are well worth repeating

Belgium has passed the point where she can under present standards feed her people but she has passed into the stage of buying raw material and selling manufactures and importing food with the proceeds This nation has become like a city in its economic life

Japan until the recent sudden shift to commerce supported itself almost entirely by agriculture with an average area of 2.6 acres per farm family They have entered on the ultimate stage of agriculture namely the garden stage of hand labour and the non flesh diet.⁴

G The Birth Rate

From these brief quotations it will be seen that many of the closely settled regions of the world, e.g., Western Europe, India, China, and Japan, are already anxious as to future food supplies This is a vital problem and is of more immediate interest than most people realize

Let us consider the North American region of settlement with its potential 600 millions The population of the United States has been doubling itself approximately each thirty years during the last cen-

⁴*World's Food Resources* (New York 1919) p 333

tury It was 25 millions in 1850, about 50 millions in 1880, and nearly 100 millions in 1910. If this rate of increase continues it will have grown to the 500 millions mentioned in the table on page 461 in less than 70 years! (See Fig 157)

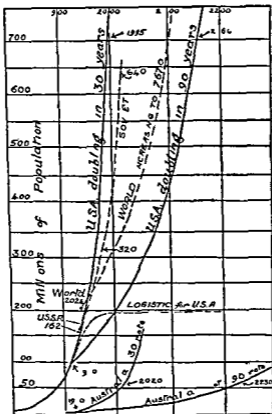


FIGURE 157 — Approximate graphs showing growth of population in the United States Australia the Soviet Union and the world assuming hypothetical rates of increase. The decline of the birth rate will of course flatten these curves as shown in Pearl's Logistic estimate for the United States.

The world as a whole according to Knibbs has doubled its population during the last ninety years. If the rate for North America drops to this figure, then it will take about 270 years to reach 700 millions.

If we consider the time which it will take the Australian population of 5 millions to grow to 62 millions (see table on p 461), we find that

it amounts to 100 years on the more rapid rate (which obtains at present), and to 320 years on the slower rate. These are much the same periods as deduced for the United States.

The Australian Commonwealth Statistician (G. H. Knibbs) concluded his voluminous report on the 1911 census with the following very pertinent remarks (p. 455):

The earth's population may be taken as 1,500 millions and its land area (excluding Polar regions) at 33,000 million acres. If we could raise 22.8 bushels of food corn per acre per annum, the total yield would only be 752,400 million bushels. The food consumption (per person) per annum is about equivalent to 5.7 bushels—which on the above computation would feed 132,000 million people.

At the rate of increase of population of 0.01 per annum (somewhat less than the rate for all countries which have accurate statistics) it would require only 450 years to exhaust the food requirements mentioned. The fundamental element in Malthus' contention is thus seen to be completely established.

In Fig. 157 various curves have been added to the original figure (of 1927). These are shown in broken lines. One of the most interesting is the famous *logistic curve* of Raymond Pearl.⁷ He studied the rate of growth of *Drosophila* (a tiny fruit fly) and found their rate of increase under certain conditions of food supply and crowding. Their growth-curve much resembled parts of human population curves. Pearl therefore suggested that the population of the United States would increase from 120 millions to 197 millions by about the year 1970 and that thereafter it would remain stationary.

This final population of 197 millions seems much too low in the writer's opinion. The unparalleled coal supplies of the United States will probably pay for food as long as any part of the world remains unsaturated.

Assuming that the world's population continues to double itself every 90 years, then it would reach Penck's 7,670 millions about the year 2120, as the curve on Fig. 157 suggests. This is less than two centuries. The last broken curve shows the remarkable growth of the Soviet population, which, as many authorities agree, may reach over 300 millions by 1975.

II Future Policy

I have shown, with some probability, I hope, the distribution of the white peoples during the next two centuries. We may expect possibly

⁷*Biology of Death* (Philadelphia, 1922).

200 millions more gradually to occupy North America, 100 millions in South America, and about the same in Siberia, and over 30 millions in South East Australia and also in South Africa. This is on the assumption that the "saturation" of Europe is approached.

I have not attempted to discuss the future of the Indian and coloured races in my 1922 paper. Already they amount to over 1,000 millions, so that one can hardly realize their increase in numbers in two centuries. For with the spread of sanitation, law, and order, the birth rate throughout Africa and Asia is not likely to diminish. If we care to adopt Penck's figure of 7,670 millions, we may assume (from my own estimate) that 1,469 of these are to be white settlers. This suggests that the 6,201 will be non-European, i.e., that the 'coloured' folk will increase to six times their present numbers.

A general decline in the birth rate is, of course, the answer to the statistical argument which I have quoted. It is difficult to imagine a crop (at present unknown) more valuable than wheat and covering every acre of land surface as Knibbs rather fancifully suggests. The general trend of this chapter seems to foreshadow a vast world struggle between higher civilizations with a low birth rate and lower civilizations with a high birth rate. This would seem to be inevitable within the next two centuries if the white nations are to maintain their dominant position. The victory is to the thrifty and sober in any prolonged economic struggle.

This is not the place to discuss the White Australian policy. Indeed few can object to it during the early and somewhat experimental stages of the Commonwealth. But Australia should beware of the effects of the absence of keen competition which such a policy may involve in the future. To quote an extreme case, this isolation to some extent accounts for the backward state of the Australian aboriginal.

It is worth while drawing attention to Professor Gulick's suggestion as to foreign immigration.⁵ He would admit foreigners, whether Europeans or Mongolians up to a fixed proportion (say 5 per cent) of those of that race already living in the country. Thus there are about 33,000 Germans in Australia he would admit 1,650 per annum. There are 21,000 Chinese he would admit 1,050 a year. There are 3,474 Japanese he would admit 173. All foreign races would be treated alike, there would be no slur on any nation, and since the

⁵ L. Gulick *The American Japanese Problem* (New York 1914)

natural increase of population has been about 100 000 a year Australia would not be swamped by aliens

Finally from the point of view of national preservation it would seem vital that the *entente* between America and Britain should be strengthened in every way possible May we not hope that as the allied victory of 1918 obliterated most of the troubles resulting from the Great Schism of 1776 so the end of the Second Great War will see the British Empire the United States the U S S R and China co-operating to maintain world peace

CHAPTER XXXIV

DEDUCTIONS AND SUGGESTIONS

A *The Study of Environmental Control*

In concluding this study of *Environment, Race, and Migration* a few general remarks on these topics will not be out of place

The writer has had the interesting experience during the last few years in Canada of investigating the fundamental geographic features of a second great section of the British Empire For twenty years he carried out similar investigations in Australia A comparison of the two studies, which deal with very different environments, has but confirmed the conclusion reached in Australia, that Man's material progress is *predominantly* the product of his environment Exaggerating somewhat, he feels that Man's part in the programme of a country's material evolution is not unlike that of a traffic policeman He can accelerate, slow, or halt the traffic, but he does not alter its direction This "Stop and Go Determinism" has no supporters among the historians, and not many even among geographers But it expresses something of the conclusions that the writer has arrived at from a lengthier study of difficult environments than has fallen to the lot of most geographers

Something of this deterministic point of view is illustrated on page 365 in connexion with the gradual exploitation of Canada The writer rather rebels against the trend seen among many geographers to exaggerate *Man's* control of his environment This tendency is emphasized among those who are strong adherents of Vidal de la Blache's "Possibilism" concept of Geography

Some years ago the author wrote a skit dealing with Egypt and the times of Tutankhamun In the first scene Pharaoh's optimistic Counsellors are advising him that the golden sands in the south of his empire have *many possible resources*, among which man may choose those which will yield bounteously to human energy In the last scene, when his tomb is opened after three thousand years of progress he eagerly looks to the south to see what has happened The sands are just as golden and just as empty!

A plea may be made for a more extensive study of Environmental Control in *general education* H G Wells puts it clearly "The end

and aim of all education is to teach of the beginnings of life upon this lonely little planet and how these beginnings have unfolded to show how man has arisen through the long ages from amidst the beasts and the nature of the struggle God wages through him¹ in effect to make folk realize that evolution is still progressing, and that *they themselves are living factors in the process*



FIGURE 158—A diagram illustrating the contents of Geography. It correlates the specified branches of the four Environmental Sciences with the four Human Sciences. Since the diagram is primarily for students in North America, this region is placed in the centre of the diagram. (From *Geography the Correlative Science in Canadian Journal of Economics and Political Science* Nov. 1935.)

Three subjects seem to be vital in the scheme of education outlined above. First *Biology* which deals with the evolution of man as an animal, secondly *History* which deals largely with the growth of his ideals and institutions, and thirdly *Geography* which deals with his present, often varying environment. This to my mind is the ultimate reason why Geography can be claimed as one of the three fundamentals of modern education.

¹*The New Machiavelli* (London 1911)

I look around the field of science and I see that almost all the most remarkable progress is being made on the *borders* of a well established subject. We shall do well to remember Isaiah Bowman's remark 'We live by advancing and changing and discovering, not by defining and hedging about'² What are the borders of Geography?

In Fig 158 I have modified an earlier diagram to suit geographical conditions in Canada. Here eight of the main divisions in the geographical field are included in the large circle, while outside this circle are eight other major disciplines with which these divisions are closely allied. The diagram suggests that Geography in a sense *links* the four "environmental sciences" of Geology, Physics, Astronomy, and Botany with the four "human sciences" of History, Economics, Sociology, and Anthropology.

Surely few subjects can be more likely to advance a knowledge of 'culture,' leading to a broad sympathy with the concerns and ideals of other individuals and peoples, than such a study as here outlined. Many of our older educationalists still believe that culture can be best attained by *classical* studies, which in the writer's opinion still bulk much too large in a *general* education. The modernist believes that these cultural ideals will rather be promoted by the study of the *human environments of today* than by the study of the dead languages of twenty centuries ago.

B The Nordic Fetish

It is interesting and rather amusing to look back on race theories of the last thirty years. In the earliest decade the Italian, Sergi, had many supporters for his theory that Mediterranean man coming from North Africa was the leading type in Europe, and was the *direct* ancestor of the Nordics of North West Europe. In the next decade books by Stoddard, Madison Grant, and others glorified the Nordic at the expense of all other racial types. If there is any superiority among the three dominant European types, the writer believes that the neglected Alpines are later types than either of the other two—and in a biological sense slightly higher, i.e., better fitted to survive than the Nordic or Mediterranean. For instance, in Europe the Alpine race has a much higher *fertility rate* than the Nordic, so that the latter stocks are rapidly dying out³.

²See his valuable educational study *Geography in Relation to the Social Sciences* (New York 1934)

³See Fig 145 in the writer's companion volume *Environment and Nation* *op cit* for a chart indicating the passing of the Nordics.

Let us briefly consider the Nordic Question. If sociologists propose to contrast the Nordic with the Alpine and Mediterranean peoples as is usual in certain American publications they must not confuse nation with race. In France the three racial stocks are perhaps nearly equally divided and in every country in Western Europe they are rather mixed. In the British Isles the people are possibly more largely Mediterranean than Nordic.

Lothrop Stoddard in his interesting book *The Revolt against Civilization*⁴ gives a table (p. 66) in support of the alleged mental supremacy of the Nordics.

Out of every 100 in the Superior Intelligence groups from Europe there are said to be

England	19.7	Ireland	4.1
Scotland	13.0	Turkey	3.4
Holland	10.7	Austria	3.4
Canada	10.5	Russia	2.7
Germany	8.3	Greece	2.1
Denmark	5.4	Italy	0.8
Sweden	4.3	Belgium	0.8
Norway	4.1	Poland	0.5

I would point out that it cannot be racial factors which place England and Holland so high while the closely allied nations of Norway and Belgium are so low in mental capacity. Moreover the almost pure Nordic nations of Denmark, Sweden and Norway make a very poor showing in this list. I have great respect for the Binet type of test but I doubt the ethnological conclusions which Stoddard bases upon the table.

C *The Status of Alpines and Mongolians*

It may very pertinently be asked: If the Alpine-Mongolian peoples are even slightly higher ethnic types than the Nordic or Mediterranean stocks, why have they not come to the front like the British (and Americans) and other West Europeans? One could reply that there are important *Alpine* strains in the West Europeans which may have largely accounted for their achievements. But I think another line of argument based on geographical controls is more to the point.

Present material prosperity and the resulting supremacy depend to a large extent on two factors: (a) Command of the sea; (b) Control of easily worked coal deposits. We have seen that racial evolution

⁴New York 1922

probably depended chiefly on greatly varying climatic stimuli. These were most pronounced in the *inland* regions of the Old World. When command of the sea became of importance, the outer rather primitive peoples had reached the seaboard, while the Alpine folk to a large extent were still inlanders. For instance, some of the later Alpine immigrants into Europe, the Slavs have only become a maritime people in one corner, i e., Dalmatia, in the Adriatic (Fig 65)

As regards industrial supremacy, this is a growth of little over a century. It is largely founded on the coalfields of North West and Central Europe, and of the Eastern United States. No one can doubt that China and Japan in another century will duplicate the material prosperity of the European or American manufacturers. One can only hope that they will manage to distribute the resulting wealth in a better fashion. The medieval nations of independent craftsmen had a happier environment than the congested, factory-ridden community of today. But it seems unlikely that China will show us the way to employ the valuable economic methods of mechanical production without also developing the slums (and millionaires) of our industrialism.

There are, of course, many other factors which account for the lagging behind of China and the Central Asiatic nations. The "ultra classical" character of the education in China, where the people were taught to look backward instead of forward, has no doubt greatly retarded their progress. The fact that the environment of the remainder of "Alpine" Asia has so deteriorated in recent times is a sufficient reason for the slow cultural advance of the *Central Asiatic* peoples.

D Racial Miscegenation

As regards racial mixture, no one desires more than the writer to see the young white nations free from those troubles which in the past have arisen when two races of very different cultures have tried to amalgamate. But we should not assume that conditions may not be happier in the future. Anyone who has seen how the educated Chinese have command of much of the East Indies, must grant that they are at least our equals in culture and commercial sagacity.

There are, no doubt, many people who are willing to concede that the Mongolian and certain of the other non European peoples are ethnically mentally, and industrially our equals but they believe it best for the white nations to keep them at a distance. Their race

prejudice is based on two genuine fears which relate to intermarriage and wage cutting. I feel sure that the time has come to view both these aspects more dispassionately than hitherto.

Most educated folk in Australia (where the writer gained most of his experience) are acquainted with Anglo-Mongolian marriages which have been quite successful at any rate where the family lives in *Australia*. It is admitted that an Anglo-Saxon wife would have more than the usual trials of the pioneer and foreigner if she were to dwell in the Celestial Kingdom where indeed the status of women is deplorably low. But my point is that an Asiatic home is not inevitably the result of a mixed marriage. The Australian women married to lower class Chinese in Australia who have come under my notice are as happy as their neighbours. Indeed in my opinion many Chinese husbands are unusually kind to their wives while Dr Harvey Sutton, Chief Medical Officer to the Education Department of New South Wales informs me that their half Chinese children are healthier and better cared for than the white children in the same environment with similar white mothers.

This very difficult problem should never be approached by people who cannot see any difference between the poorly educated Negroes of the United States of America who are only a few generations removed from the barbarous cannibals of Dahomey and the cultured Mongolian or Indian of at least our own ethnic status. There is absolutely nothing in common in the two cases. Critics forget that in South America the experiment has been working for 200 years. In Chile as Lord Bryce has pointed out* the Mestizo (half Spanish half Amerind) is at least as good a citizen as the Argentine peasant of practically pure Spanish descent. Here the rather primitive blood of the Spanish (a marginal Mediterranean type) is mingled with a higher stock (akin to the later Polynesian) to which many of the Amerinds belong. We should remember that the above Mestizo is very similar in racial origin to the British Chinese half castes mentioned above.

E Cultural Difficulties Soon Overcome

However there is another line of thought developing from this type of investigation which should be of interest to many readers of this book. To the author it seems one of the most helpful concepts in the whole field of international research. If it can be shown—and

**South America* (New York 1913)

I believe my book goes a long way to prove this—that all the progressive nations of the world are essentially built up of the three stocks "Alpine, Nordic, and Mediterranean," then much of the evil structure based on "race prejudice" falls to the ground. In my opinion "race prejudice" is but another term for ethnological ignorance. Such prejudice is based on very real differences of *culture*—but in the majority of cases the biological differences are negligible and certainly do not constitute racial differences. For instance, the *racial* difference between some of the broad headed "Yamato" of Japan and the broad headed Englishman of Kent (who are both essentially Alpine) is negligible compared with the biological gap which separates both from the little dark man of Devon or the primitive folk of Central Wales.

This is a very encouraging idea, for cultural differences of habit, education, and religion can be entirely changed in a generation where as a real *racial* barrier is much more difficult to overcome. Thus the world must wait a long while for the Negro problem (based on a real racial difference) to be solved. But racial differences exactly like those separating Europeans, Japanese, Chinese, Indians, and Amerinds have all been smoothed away in Europe itself, where (in the writer's opinion) their component stocks came in contact with each other long ago in Neolithic times.

No one is competent to discuss miscegenation who has not studied the evidence from Hawaii. Here the developing Chinese Hawaiian hybrid is under investigation.⁶ At Kawai'ahao Seminary children of the following mixed ancestry are working together, hybrids of Hawaiian with all kinds of European, Filipino, Japanese, Indian, Chinese, Negro, and Mexican stocks. One girl's ancestry is Hawaiian-Chinese-German Norwegian Irish. Where there is no *social* disability due to such mixing, it is not easy to prove any biological disadvantages.

However, the economic argument is the crux of the whole problem. We fear the invasion by hordes of lower paid, more industrious Asiatics. It is natural to prefer to keep our own country entirely to ourselves, just as the Chinese decided in the eighteenth century. But shall we not suffer greatly from it in the future? A small influx of Chinese (say, on Gulick's plan)⁷ would greatly stimulate tropical settlement in Australia and elsewhere. Domestic labour and agri-

⁶*Eugenics in Race and State* (Baltimore, 1923)

⁷*American Japanese Problem* (New York 1914) p 284, cf p 334

culture would benefit at once. There are many ways of ensuring that these immigrants shall never rival the natural native born increase. A healthy competition would be developed which in similar cases has resulted in the benefit both of native and immigrant. One may instance the Huguenot migrations. Chinese carpenters and gardeners have not ousted white labour, but I imagine they must certainly have shown the European that he must do thorough work if he is to hold his own in the industrial world of the future.

But more important perhaps than all this we should show Japan and China that we recognize their undoubted claim to racial equality. In the future when China is one of the Great Powers we shall reap the benefit of a far seeing policy of the kind indicated briefly above.

The writer has closely studied this race problem for many years. The whole trend of racial history in the past points to an amalgamation of peoples in the next few centuries on a scale never before accomplished. I can see nothing which is likely to prevent the ultimate mingling of the European and Chinese types to produce a dominant race somewhat resembling the Slavs and Western Asiatics around the Caspian Sea where indeed the same mixture has probably occurred through the ages.

It is surely wisest to look ahead and study possibilities. No folly can be greater than stifling scientific discussion of such problems.

As regards the *Negro peoples* theirs is a very different and very difficult problem. The rather poor achievements of the Negro race in world history are probably due to their non stimulating environment. To this also is due their small advance from a primitive stage of racial evolution. Racial mixture with Negroes (of the average type) hardly seems likely to produce a biological improvement. But we should suspend final judgment until they have had equal opportunities with the other races for several generations.*

Yet here again the past shows I think what will happen. An ever increasing proportion of half castes will arise. These while inferior to the white races are more capable of holding their own than the Negro and the latter will ultimately disappear. The half caste in time will then merge in the remainder of the world's population. Such is to a considerable extent what is happening with the Australian aborigines as the following table indicates for the State of New South Wales (see Fig. 37).

*See J. W. Gregory *Menace of Color* (London 1925) for a sympathetic review.

	<i>Full bloods</i>	<i>Half castes</i>
1882.....	6,540	2,379
1892....	4,458	3,015
1902	2,880	3,948
1912 .	1,917	5,117
1921 .	1,281	6,270
1933 . . .	599	3,115*

*In supervised camps, about four thousand are not supervised.

It is a very important fact, and one which is not realized by the public, that the birth-rate of the Negro in the United States is rapidly falling off. In the north in 1920 the proportion of Negro children to women was only 63 per cent of the similar proportion for white folks. Even in the south in 1920 it was 5 per cent less than the proportion for white folk. W. F. Willcox⁹ states that "whereas the Negroes were one-fifth of the community at the first census, by the end of this century they are likely to be not more than one-twentieth."

Finally, as regards *racial exclusion*, it seems to the writer that this is the chief world-problem of today. Apart from the Negroes, he can see no reason for saying that one race, in any important aspect, is better than another. Chinese, Japanese, British, Indian, "Nordic," "Alpine," and "Mediterranean" have all made good in suitable environments. Hence he would say that eugenics rather than nationality is the best criterion for those responsible for racial exclusion. As regards the future, it seems clear that *environment* will be the most potent factor in moulding every race and nation.

The aftermath of the Great War has been a poisonous growth of Nationalism and High Tariffs all over the world. Yet it is difficult to see what can take the place of re-armament in face of the aggressive tactics of the militaristic nations. But such measures do little to *remove* the evils menacing the world. Britain and the other democratic nations must strive to increase international goodwill by promoting better economic relations with all other countries. This means sacrifices in trade and in territory. Goodwill among nations, as among individuals, is best proved by giving up material advantages. What these should be is to be decided by the statesman and economist rather than by the geographer.

The ideal towards which the most enlightened statesmen are working is surely a World at Peace. The chief obstacles in the way are race-prejudice and national jealousy. The former will soon de-

⁹*Eugenics in Race and State, op cit*, p. 174

crease when leaders of the public learn some ethnology. The latter will tend to diminish as each nation realizes the place in the world's order of precedence for which its racial, intellectual, and economic status equips it.

The foregoing study is an attempt to investigate some of these ethnological and economic problems. If it helps, in however small a degree, to promote the brotherhood of man, the writer's main object will have been accomplished.

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